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"Artificial Intelligence Empowered Business Processes"

Edited by

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PREFACE

Welcome to the 19th International Conference on Electronic Business (ICEB 2019) in Newcastle upon Tyne, United Kingdom. The theme of this year's Conference is “*Artificial Intelligence Empowered Business Processes*”. We received 109 submissions and 78 papers were accepted into the final program that consisted of 24 sessions. There were 46 full papers of which 6 were selected to receive the “Best Paper Award”. The topic areas of the papers in this conference include e-business, smart cities, e-commerce and e-retail, artificial intelligence and its applications, blockchain and smart technologies, digital transformations in enterprises, social media and social commerce, e-supply chain management and e-logistics, smart tourism and hospitality, knowledge management and sharing, e-healthcare and e-entrepreneurship, co-creation in e-business, E-marketing, e-consumer behaviour and e-CRM, big data analytics and business intelligence, new technology acceptance and adoption, and strategies and models of electronic business.



On the opening day, we have scheduled four keynote speakers: Prof Pär J. Ågerfalk, the Chief Editors of *European Journal of Information Systems*; Prof. Patrick Y.K. Chau, the Chief Editor of *Information and Management*; Prof. Feng Li from Cass Business School at City University of London; and Laura Partridge, Digital Programme Lead, North East Local Enterprise Partnership in United Kingdom. Continued with the practice from last year, we have adopted virtual meeting for those who are not able to attend the meeting due to special reasons.



We have followed the previous year's tradition to create a special session: “*Meet the Editors*”. In addition, a new workshop on Artificial Intelligence with Python was created on Wednesday 11th December. This year, we have started up a new initiative to set up a sponsorship invitation to both academic institute and industry. Fortunately, ICEB2019 was sponsored by Newcastle Business School from Northumbria University and a local SME from Newcastle.

The annual conference of ICEB is an excellent opportunity for the scholars like you and me to share research ideas and get informed about the latest development in the fields. We could meet leading scholars from around the world to establish a research network and engage in future collaborations. In this conference, there are 88 registered scholars from 17 countries or regions, including Australia, China, Finland, Greece, Germany, Hong Kong, Japan, Lithuania, Malaysia, New Zealand, Saudi Arabia, Singapore, U.S.A, UK, Switzerland, Thailand, and Taiwan. After the conference, 63 titles are included in the final proceedings book containing 46 full papers, 12 works in progress, and 5 abstracts.

Finally, we would like to thank you for your participation in this conference, without which it will not be

successful. We also thank all the speakers, presenters, reviewers, the program committee members, and session chairs, who all have contributed their efforts and support to this conference. Special thanks go to our conference staffs, faculties and students from Northumbria University, who had planned and executed the conference events tirelessly and effectively. Finally, on behalf of the entire Conference Committee and the Hilton Newcastle Gateshead Hotel staffs, we sincerely wish that the experience during your stay in Newcastle upon Tyne, UK was very delightful and memorable and we look forward to seeing you again in ICEB 2020 in Bangkok, Thailand.

Sincerely yours,

Eldon Y. Li

Eldon Y. Li
ICEB Honorary President
Chair Professor
Chung Yuan Christian University, Taiwan
& Tongji University, China

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December 2019 in Newcastle upon Tyne, United Kingdom

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A Sentiment Analysis of Peer to Peer Energy Trading Topics from Twitter (Full paper)

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ABSTRACT

The emergence of the Peer-to-Peer (P2P) energy trading platforms provides a new method for the general public to use and trade green energy. How to design the peer to peer energy trading platform thus becomes important in facilitating user trading experience. This study will use the data mining method to evaluate factors impacting P2P energy trading experience. Python was used to analyze data extracted from Twitter and Natural Language Processing (NLP) method was implemented with hierarchical Latent Dirichlet Process (hLDA) model. . The study's findings will be examined in detail.

Keywords: Peer to Peer energy trading, data mining, hLDA, feature engineering

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INTRODUCTION

P2P energy trading is a type of Collaborative Consumption (CC) service involving direct energy trading among peers such that local energy prosumers as well as consumers trade small-scale Distributed Energy Resources (DERs) energy in offices, dwellings, and factories (Zhang, Wu, Zhou, Cheng, & Long, 2018). It can be observed that this had a considerable positive impact on the market share of renewable energy (Andoni et al., 2019), balancing energy consumption and generation (Mengelkamp et al., 2018), environmental outcomes (Morstyn, Farrell, Darby, & McCulloch, 2018), and cost saving (Zepter, Lüth, del Granado, & Egging, 2019).) CC can be seen as a type of the sharing economy and occurs either in organized systems or in networks such that participants implement sharing activities such as lending, renting, trading, swapping, and bartering goods, transportation solutions, services, money, or space (Möhlmann, 2015). CC has enabled the transformation of traditional consumption communities from local marketplaces that have restricted economic activity into collaborative global communities that can have significant social, economic, as well as environmental impacts (Perren & Grauerholz, 2015). This, as noted by Heinrichs (2013), can result in a new style of sustainability. Further, Peer-to-Peer (P2P) online platforms aid the CC services' infrastructure while leading to various sectors that have enabled small suppliers to challenge the traditional goods and services providers (Hagiu & Wright, 2015). For example, Airbnb helps in renting a spare room to those who need it and CarNextDoor helps in lending a car. Although various projects including Peer Energy Cloud in Germany and Transactive Grids in US (Park & Yong, 2017) have been encouraged, the applications have not expanded at the expected rate (Bray, Woodman, & Connor, 2018). There are gaps in literatures concerning reasons behind users' participation in such a collaborative activity and factors discouraging users from participating in it. Moreover, not only can the new P2P energy trading, within a short period of time, notably oppose the current energy market structure (Andoni et al., 2019) along with the current experimental projects, but the communication gap between prosumers has been observed to be a major reason impacting the P2P energy trading platform's effective operation (Morstyn, Hredzak, & Agelidis, 2016). Compared with the similarities and differences among different p2p energy projects, many of the trails focus on business models acting similarly to a supplier's role in the electricity sector, it is also necessary to design the necessary communication and control networks that could facilitate P2P energy trading among local Microgrids (Zhang, Wu, Long, & Cheng, 2017). How to design the P2P energy trading platform so that it will provide an optimized user trading experience is thus important for the P2P energy platforms.

The CC literature indicated that factors influencing collaborative consumption platform usage includes community belonging, economic drives, environment impact, technology innovation, and trust (Barnes & Mattsson, 2016; Brown & Venkatesh, 2005; Hamari, Sjöklint, & Ukkonen, 2016). Studies have observed the profile of CC users and the factors impacting their services including studies on Airbnb (Möhlmann, 2015) and car sharing (Bardhi & Eckhardt, 2012). Although P2P energy trading is considered a type of CC, its nature charterers make it slightly different. For example, the frequency of using Airbnb in 2015 was 3.3 times per year (Tussyadiah, 2016) which is far less than the frequency of using energy which is required 24/7. There is a research gap on which factors influencing P2P energy trading. Studies concerning energy consumers' motivations have noted major extrinsic factors including technology innovativeness, economic benefits, and environmental benefits (Langheim, Arreola, & Reese, 2014; Michelsen & Madlener, 2013). As per Roy, Caird, and Abelman (2008), energy prosumers have motivations such as the rising fuel prices, technological cleanliness, and active personal contribution to protecting the environmental. According to Bleicher and Gross (2015), environment-friendly technology as well as economic feasibility are the major contributing factors. Caird and Roy (2011) noted that intrinsic factors such as the pleasure of being the owner of and using environment-friendly technology is important. When the transformation of customers to both producers and consumers, motivations also changed. That is, considering P2P energy trading as a collaborative consumption service can lead to several

motivations as prosumers are expected to have their own preferences regarding risk-aversion, financial return, energy securities, as well as environment/social concerns (Darby, 2013).

This present study aims to fill this gap by examining factors impacting P2P energy trading. Hence, the present study will examine the gaps in literature based on the factors influencing using CCs, while noting the differences compared to other CC services including Airbnb. This study also intends to use the Natural Language Processing (NLP) method to assess factors that impact P2P energy trading experience. In particular, the data in this study will be obtained from Twitter and assessed using the NLP method's Hierarchical Latent Dirichlet Process (hLDA) model with python. The study can make theoretical as well as practical contributions in three major ways. First, examining the reasons for energy trading can help resolve the communication problem among customers and prosumers. Second, it may help by offering significant insights for P2P energy trading shareholders and enable better decision-making. Third, the new NLP analytic methods concerning energy trading can offer a new method to evaluate the CC motivations.

LITERATURE REVIEW

The Context Of Peer To Peer Energy Trading

From the late half of 1990s, Europe has completely implemented Information and Communication Technology (ICT) use in distributed power networks, and as noted by Park and Young (2017), it has been expected that, in the future, individuals will be able to exchange the distributed power source generated electricity, thus ensuring the prosumers and consumers' exchange regarding the surplus energy. Moreover, they also suggested that there has been increased encouragement for energy trading platforms on a global scale, including Peer Energy Cloud in Germany, Open Utility in the UK, and Brooklyn microgrids in the US. According to Montemayor, Boersma, & Dorp (2018). Until 2018, there were 143 P2P energy projects in the world, beside of this, the top 3 countries are the Netherlands, Germany and the US. Most of the action (over 64%) is concentrated on the European continent.

P2P energy trading is crucial as it enables customers to transform into prosumers because of DERs technology. Further, as new proactive customers replace the typical passive consumers' traditional identity, it has led to changes in energy power networks that continue evolving. Typically, every country has certain major players in the energy industry that control the centralised power distribution, and because of such centralised conventional energy transition, consumers used to be passive concerning the power network. The introduction of ICT-based smart grid technology, however, enabled substantial amount of data from various sources to be collected and assessed. The data sources include Internet of Things (IoT) devices, sensor networks, and wearable devices (Pieroni et al., 2018) that have allowed two-way communications between prosumers and consumers. As noted by Khan et al. (2013), many researchers have examined this subject by using techniques such as home automation, advanced metering infrastructure (AMI), smart meters, and home area networks (HANs). Such technologies have aided in promoting communication's bidirectional nature which has not only increased the efficiency of energy but also allowed electricity consumption to be better evaluated, planned, used, as well as modified (Parag & Sovacool, 2016). Vehicle owners as well as consumers can re-assess from where they purchase energy and how they use it because of new technologies including vehicle-to-grid electric automobiles and smart meters, be it through trading energy with small-sized and medium-sized agents or directly. Zhou, Wu, and Long (2018) noted that P2P energy trading has a distinct approach in which operators offer a local market platform that has the required functions to ensure that individual benefits are achieved as it helps prosumers trade and share energy with one another. Agents who consume as well generate electricity are prosumers. A major advantage of this framework is that it allows prosumers to gain control over their individual DERs, because of which participation is ensured without motivational incentives. Further, as per Hagi and Wright (2015), these trading platforms help smaller-scale suppliers in competing with more traditional and larger companies which provide services and goods and have thus emerged in numerous sectors. Hence, it has led to a new power system operation model which is energy trading on microgrids. According to Zhang et al. (2017), this model will help people generate their own energy in domestic settings, offices, and factories through Renewable Energy Sources (RESs) that can also be shared and traded locally in their community.

It should be noted that all P2P energy trading platforms have to address the problem of network's nodes which handles the local supply and demand while considering the energy prices and grid conditions. Moreover, as noted by park and Yong (2017), it is difficult to implement communication between various DERs effectively through energy storage systems (ESS). Morstyn et al. (2018) stated that it is important to combine DERs, control, and consumer communications, but as predicting customer preferences is difficult, P2P energy trading communication also becomes difficult. As per (Zhang et al., 2017), previous studies have focused on business models as well as platforms functioning in a manner similar to the role of a supplier in the electricity sector. On the other hand, local P2P energy trading must have a communicated and controllable network which has a current trading data-based trading network so that it is effective.

The Public Blockchain Platform is a P2P energy trading infrastructure and is largely used in existing trial projects. Its developers describe Blockchain as a distributed ledger which helps individuals conduct transactions with one another without requiring a reliable third party such as a bank. Now, the ledger become numerous models that are applicable to various business problems and can drastically enhance information sharing (Hancock, 2016). For example, the US-based Brooklyn Microgrid that can coordinate DERs for continuing supply in case of the microgrid being separated from the main grid. In such a platform, prosumers tend to be incentivised based on the shared aims, including minimising local pollution, for developing

microgrids as well as other community energy initiatives. Such community-based goals help in creating more awareness about P2P energy trading platforms and ensure that local users provide support.

The World Energy Council (2018) noted that it is important to be careful for ensuring that such a balance is sustained when rapidly transitioning to new digital, decentralized, and decarbonized systems because of the risk of trade-offs developing between the priorities that can hinder their critical balance. As per Morstyn et al. (2018), it is important that extant power networks keep ensuring that customers can access affordable energy in a secure and universal manner while transitioning to a zero-carbon emissions model. Boroojeni et al. (2016), however, believes this is difficult as their energy model is primarily dependent on non-renewable fossil fuels. Further, according to Morstyn et al. (2018), using P2P networks for conducting energy trading is important as they can help prosumers establish prices for transactions as well as determine complementary resources and help in service coordination.

In addition, there are regulatory barriers that oppose the P2P energy trading application. Consider the Piclo for example which is a first P2P energy trading project that was established in 2017 in the UK (open Utility, 2015), with all transactions currently mandated to be conducted through a licensed supplier while customers having only one licensed supplier (as with Piclo). Hence, a domestic prosumer such as solar PV cannot sell any additional generation and must either store it on site or sell it through the supplier to the grid. On the other hand, a customer also cannot buy electricity from anyone apart from their sole contracted supplier. Bray (2018) noted that, today when households are able to buy various products from diverse companies, such a 'supplier hub' model can be a hindrance.

Motivations To Adopt Peer-To-Peer Energy Trading

It can be helpful to identify factors which determine the P2P energy trading usage intention as it can help understand CC behaviour as well as identify the feasible tasks of enhancing P2P energy trading providers' service quality (Tussyadiah, 2016). Hence, it is necessary to examine the influential factors concerning P2P energy trading experience for understanding its motivations. According to the self-determination theory, as noted by Deci and Ryan (1985), motivations can be classified into intrinsic and extrinsic. The extrinsic motivation concerns pursuing valued outcomes that differ from the activity, such as reduced cost or increased income. On the other hand, the intrinsic motivation emphasises the advantages of performing an activity, including perceived enjoyment, instead of the outcome. Studies regarding the motivation behind energy consumers showed major extrinsic factors included technology innovativeness, economic benefits, and environmental benefits (Langheim et al., 2014; Michelsen & Madlener, 2013). As noted by Roy et al. (2008), the motivations behind energy prosumers are rising fuel prices, technological cleanliness, and active personal contribution towards protecting the environment. Further, as per Bleicher and Gross (2015), environmentally friendly technology as well as economic feasibility are major contributing factors. Caird and Roy (2011) also stated that intrinsic factor which is the expected pleasure of owning as well as using environment-friendly technology is important.

Following the conceptualization in previous studies of motivations of CC, community belongings is the first factor which previous study always identified. Studies have highlighted the importance of belonging to a community (Närvänen, Kartastenpää, & Kuusela, 2013) because a community is important for participating in sharing actives (Albinsson & Yasanthi Perera, 2012). Further, the CC fulfils consumers' social needs that include wanting to socialise (Rachel Botsman & Roo Rogers, 2010) as well as a sense of belonging or being included in a community. Previous studies have noted how much sharing economy impacts the social ties' development or strengthening and the creation or improvement of participants' sense of community (Rosen, Lafontaine, & Hendrickson, 2011).

The second factor impacting CC motivation is environmental impact. Phipps et al. (2013) noted that enhancing the environmental, economic, and social impacts of consumption can address the existing as well as future generations' needs. Hamari et al. (2016) also stated that the sustainable activity of collaborative consumption can increase participation.

Another significant factor is economic benefit that can impact CC motivation. Moreover, participating in sharing can be a rational and utility enhancing behaviour in which exclusive goods ownership is replaced by the consumer with a CC service lower cost options (Belk, 2009). Apart from this, reward is also a type of economic benefit that affects CC services use. Both the intrinsic and extrinsic motivations of participation in open source development, and find that a strong extrinsic motivation is the potential future rewards, such as economic benefits (Alexander Hars, 2002).

Further, enjoyment is a significant determining factor behind intrinsically motivated use because the social networking services as well as similar service design that is utilised elsewhere can enhance relatedness (Deci & Ryan, 1985). Santoso and Nelloh (2017) noted that enjoyment can positively impact customer satisfaction as well as be insignificant regarding future intention.

Attitude is another determining factor concerning CC. According to traditional theories regarding consumer behaviour, as noted by Woodside and Lysonski (1989), attitudes are crucial in the decision-making process and can have a considerable impact on consumer behaviour. Attitude refer to a temperament of favourably or unfavourably responding to a person, object, event, or institution (Ajzen, 2005) that can affect such an intention (Ajzen & Fishbein, 1977).

Another factor is technological innovation that impacts CC motivations. One of CC's significant characteristics follows web 2.0 (Belk, 2009). According to studies on innovation theory, people tend to implement an innovative technology when they believe that it offers certain advantages compared to their current methods and when the technology is less complicated (R Botsman & R Rogers, 2010). That is, consumers prefer trying a new service or product if the technological innovation is able to provide more convenience as well as economic benefit.

Perceived Risk is also a major factor that has a negative impact on the purchase intentions of customers. Perceived risk is the extent one's belief of the uncertainty regarding there will be desirable outcomes (O'Leary-Kelly & J. Vokurka, 1998). In terms of the perceived risk in studies on e-commerce, privacy, credibility, and security are the main issues (D. L. Hoffman, T. P. Novak, & M. Peralta, 1999). In the e-commerce industry where goods are permanently sold for money, it is important that the sharing economy property be returned to its owner following a previously established usage and condition period (Belk, 2014). The perceived risk leads to loss of chance of continued use of the services.

Moreover, trust is a significant factor for determining CC. Trust refers to a subjective belief that one party has about the trustee or the prosumers acting in a way that the other party, such as the consumers, expects during an exchange, transaction, or interaction (Gambetta, 1988). According to L. Hoffman, P. Novak, and A. Peralta (1999), lack of trust is a major reasons for individuals not conducting online transactions, while humans are naturally inclined to trust and determine trustworthiness (Wu, Hu, & Wu, 2010).

It has also been observed that reputation is crucial in determining participation in communities as well as other online collaboration activities including information sharing (Hamari et al., 2016). As noted by Alexander Hars (2002), self-marketing as well as reputation building are significant indicators of the possibility of online collaboration.

Consumer and service studies have noted that perceived quality is a major precursor to satisfaction as well as the intention of again using this service (Cronin Jr & Taylor, 1992). Regarding CC, for example, a car sharing service user or accommodation marketplace user may have greater likelihood of using this service again if they have a positive experience with customer service. Further, Möhlmann (2015) noted that service quality is necessary for ensuring satisfaction and that an option of sharing and additional service quality form new components to assess the success of information system (DeLone & McLean, 1992).

Table 1 Overview of service attributes that appeared in previous studies on CCs services

Authors	Community belongings	Reputation	Trust	Service quality	Environment Impact	Economic Benefit	Technology Innovation	Enjoyment	Attitude	Perceived Risk
(Tussyadiah, 2016)	x				x	x		x		
(Hamari et al., 2016)		x			x	x		x	x	
(Möhlmann, 2015)	x		x	x	x	x	x			
(Santoso & Nelloh, 2017)					x	x		x		
(Yang & Ahn, 2016)		x			x	x		x		x
(Guttentag & Smith, 2017)	x			x		x	x			x
(Zervas, Proserpio, & Byers, 2017)			x	x		x				
(Mittendorf & Ostermann, 2017)	x		x							x

METHODOLOGY

In recently research, NLP can automatically determines which entities are being referred to by the text using both natural language processing techniques and analysis of information gleaned from contextual data in the surrounding text based upon input of a text segment (Liang, Koperski, Dhillon, Tusk, & Bhatti, 2013). Meanwhile, the exploration of Topic Models started

from the field of natural language processing (NLP) and information retrieval (IR) (Steyvers & Griffiths, 2007). A large amount of unstructured and unlabeled document were represented and clustered with different topics according to the co-occur frequently in the documents (Sun et al., 2016) Topic model are well used in different subjects, such as comparing twitters and traditional social media (Zhao et al., 2011); analyzing user reviewers in tourism (Rossetti, Stella, & Zanker, 2016) and for open ended survey responses (Roberts et al., 2014).

Data Collection

We collected data from Twitter, a social media platform where users can post their opinions or 'tweets'. Twitter has been a valuable and important source for analysing public opinions (Pak & Paroubek, 2010). We have used the keyword "peer to peer energy trading" to extract 3700 sample tweets from 2009 to 2019. The official Twitter API has a limit of 100 tweets per request and it can only allow users to trace back to maximum six days. Therefore, another unofficial tool based on Python, called 'TwitterScraper'(Taspinar & Schuirmann, 2017) was used to collect all related tweets. The data collected consists of ten columns, including 'user', 'full name', 'tweet ID', 'date and time of the tweet', 'tweet URLs', 'likes', 'replies', 'retweets', 'tweet text', and 'html'.

Data Pre-Processing

Only tweet texts were extracted. As we needed to analyse the topics, we only focus on the tweets they posted and removed other variables collected through TwitterScraper, such as likes and retweets.

URLs were removed. Some tweets contain website URLs, such as 'P2P energy trading"the grid will become a market for making many-to-many connections between suppliers and consumers" <http://reneweconomy.com.au/2014/building-the-electricity-system-of-the-future-84762>'. Scholars believe that URLs in tweets are not helpful for analysing sentiments and thus, we remove all URL links (Pak & Paroubek, 2010).

Tokenisation, stemming, stop words removal and corpus generation. A specialised python package called TweetTokenizer in NLTK (Loper & Bird, 2002) library was used to tokenise the tweet texts. Then, we stem the words using Porter's stemming algorithm (Porter, 1980). We remove all stop words that used for grammar but are not necessary for understanding the meaning of tweets, such as 'that', 'which', 'on', 'in'. We also remove those words (e.g. 'p2p', 'blockchain', 'energi', etc.) occurring in nearly all tweets. The results after the filters mentioned above become the 'corpus' for topic model. (Schütze, Manning, & Raghavan, 2008).

Hierarchical Latent Dirichlet Process.

Latent Dirichlet Process (LDA) was mostly used in the topic model, which includes both unsupervised and supervised topic model to extract potential topics and also provides a generative probabilistic model form the collections of discrete data, for example, the text corpora (Blei, Ng, & Jordan, 2003; Mcauliffe & Blei, 2008). LDA model has been adopted in many fields. For example, Guo, Barnes, and Jia (2017) use LDA on 266,544 online hotel reviews to identify nineteen controllable dimensions, such as park, car and street. The LDA is based on the Bayesian approach as below and it assumes that the words in each text are drawn from a mixture of baskets independently while each basket contains a set of words and the generative process for each tweet, D (Blei et al., 2003). LDA includes different types of variants, such as the Author-Topic Model which is used to address authorship information (Rosen-Zvi, Griffiths, Steyvers, & Smyth, 2004); The Dynamic Topic Model which can analyze the time evolution of topics in large document collections (Blei & Lafferty, 2006); the Relational Topic Models which can summarise the networks among different documents and predict the links among them (Chang & Blei, 2009).

This research employed the Gibbs sampling for the Hierarchical Latent Dirichlet Process (hLDA) to extract the topics and their hierarchical relationships. hLDA is based on the Latent Dirichlet Allocation (LDA) model and a non-parametric prior called the nest Chinese restaurant process (Griffiths, Jordan, Tenenbaum, & Blei, 2004). Griffiths et al. (2004) describe the process as follows:

- 1) Let c_1 be the root restaurant.
- 2) For each level $l \in \{2, \dots, L\}$:
 - (a) Draw a table from restaurant $\overline{c_{l-1}}$ using the following 2 equations:

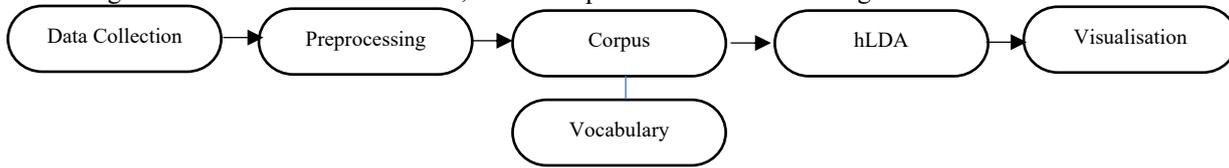
$$p(\text{occupied table } i \mid \text{previous customers}) = \frac{m_i}{\gamma + m - 1}$$

$$p(\text{next unoccupied table} \mid \text{previous customers}) = \frac{\gamma}{\gamma + m - 1}$$
 Where m_i is the number of previous customers at table i , and γ is a parameter.
 - (b) Set $\overline{c_l}$ to be the restaurant referred to that table.
- 3) Draw an L-dimensional topic proportion vector θ from $\text{Dir}(\alpha)$.
- 4) For each word $n \in \{1, \dots, N\}$:
 - (a) Draw $z \in \{1, \dots, L\}$ from $\text{Multi}(\theta)$.
 - (b) Draw $\overline{w_n}$ from the topic associated with restaurant $\overline{c_z}$

Comparing to traditional LDA, hLDA has two main advantages: 1. hLDA can explore the hierarchical relationship between topics; 2. Instead of manually choosing the number of topics K in LDA, hLDA can automatically choose the optimal number of topics.

This research used the Python 2 code ‘Gibbs sampler for the Hierarchical Latent Dirichlet Allocation’ by (Joe, 2017). The results were transformed into structured data and were visualised using Flourish.studio.

According to the aforementioned methods, the whole process is shown in the figure 1 below:



RESULTS AND FINDINGS

Root Topic

A three levels Hierarchical topics model has been developed as per the hLDA. The root topic keywords include ‘platform’, ‘renew’, ‘solar’, ‘base’, and ‘use’ and are a total of 5188 words, as shown in figure 2.

Level 1- Subtopics

Considering the hierarchical root topics visualisation illustrated in figure 2, the root topics include 12 subtopics, as presented in table 2.

Table2: 12 level 1 subtopics

Number	Topic	Total words
1.	Solar, trial, Australia, microgrid, news	877
2.	World, enable, help, become, platform	800
3	Deploy interest, present, residences, exchange	758
4	Start up, via, storage, electricity	543
5	Ucl, model, present, group, balancing	500
6	Think, live, help, commodity	453
7	Aim, take, new ,recent, model	354
8	Network,microgrids,excitement, sustain,	307
9	Panel, want, suncontract, larger, retail,	266
10	Chain, system, made, Brooklyn, account	120
11	Explore, chance, point, even, another	105
12	Good, meter, unit, bitcoin	84

Level 3-Subtopics

In topic 1, the third level subtopics with the highest frequency include project set up (261), news, blockchain technology (41), Initial Coin Offering (ICO, 61), and coin payment (figure 3). It also included four countries: Australia, Ireland, Thailand, and Singapore.

In topic 2, the third level subtopics with the highest frequency include fuel, source (261) ICO, wind, electric, wholesale, price, New Zealand (42), marketplace (194), and licences (5) (figure 4).

In topic 3, the third level subtopics with the highest frequency include first system, Britain (12), Chicago(218) social house, friends, family, multifamily (12), interact, buy(11), neighbour, cost, community(22), and fixability (14) (figure 5).

In topic 4, the third level subtopics with the highest frequency include clean (139) product, better (87), plant, reduce emission (82) understand, virtual, and demand (11) (figure 6).

In topic 5, the third level subtopics with the highest frequency include Ethereum (86), tokenpost, power token (23), energy coin (9), and altcoin (31) (figure 7).

In topic 6, the third level subtopics with the highest frequency include need, participants (65), traditional, government (19), licence (19), and permit (8) (figure 8).

Thus, the previous section has presented the hLDA model’s top six topics as well as every topic’s mean sentiment polarity score. The results show that when people on Twitter discussed energy trading, they largely presented ten types of information, as given below.

1. Countries:

As stated in topics 1 and 2, the majority of countries included are developed countries, such as the UK, Australia, and New Zealand. As mentioned in the literatures, 79% of current P2P energy projects

2. Trial stage:

The P2P energy trading project still on the trial stage.

3. News:

P2P energy projects news and the ICO news are the majority of the keywords included in topics 2 and 5 with news. Thus, on Twitter, the majority of the resources on Twitter are news and most discussion on this subject concern the energy coins' ICO.

4. Communities:
Topic 3 includes communities and neighbourhood that is also affirmed by Zhang et al. (2017). This also shows that P2P's original aim is to help local communities as well as neighbours in selling and exchanging their energy.
5. Environmental benefit:
Included in topics 2 and 4, helping reduce emission was energy sources represent what kind of source will be delivered in the trading progress, might be solar or another kind of renewable energy. It is, therefore, necessary to take into account whether the diversity of energy sources should be included as a feature in P2P energy trading system. Though more options can create more difficulties when making decisions, assessing this feature can also be helpful for future application.
6. Economic benefit:
Included in topics 2 and 3, P2P energy trading platform ensures that the energy trading is more flexible and decreases its reliance on the traditional energy networks. Various platforms, however, have different price strategies and P2P energy trading results in challenges for the existing energy marketplace.
7. Blockchain technology:
As noted in topic 1, block has significantly high frequency because of the existing blockchain projects, including Powerpeers. On the other hand, due to some the data are from the news which discussed Brooklyn microgrids a lot, which is the first peer to peer energy trading project in the world.
8. Payment and energy coins:
As per topic 5, the determinates concerning payments are included in (Lee & Kozar, 2006; Rose, Hair, & Clark, 2011). This, future P2P energy trading project must take into account implementing tokens as a rational currency concerning the final payment. On the other hand, the trust issue and risk must also be considered because the public continues to be worried about the news payment using energy or environment coins and replacing typical bank payment.
9. Adequate product information:
As noted in topic 4, lack of sufficient information can result in unfamiliar services and platforms that can hinder customers from using it in the future.
10. Regulation and network constraints:
As stated in topic 6, P2P energy trading regulations continue to be a constrain regarding the development of platform. Bray (2018) noted that all transactions at present have to be conducted by a licensed supplier and that customers are only allowed to have one licensed supplier (as with Piclo).

As opposed to CC studies, the present study's results do not include reputation and enjoyment. On one hand, this is due to the data sources, most of the twitters are sent from the experts and lack of enough customers. However, as the majority of these projects remain in the trail stage, it leads to small data concerning the project feedbacks and reviews. Moreover, the high frequency of using one's own energy has led to customers not considering reputation or enjoyments and focusing more on economic benefit, environmental benefit, and payment.

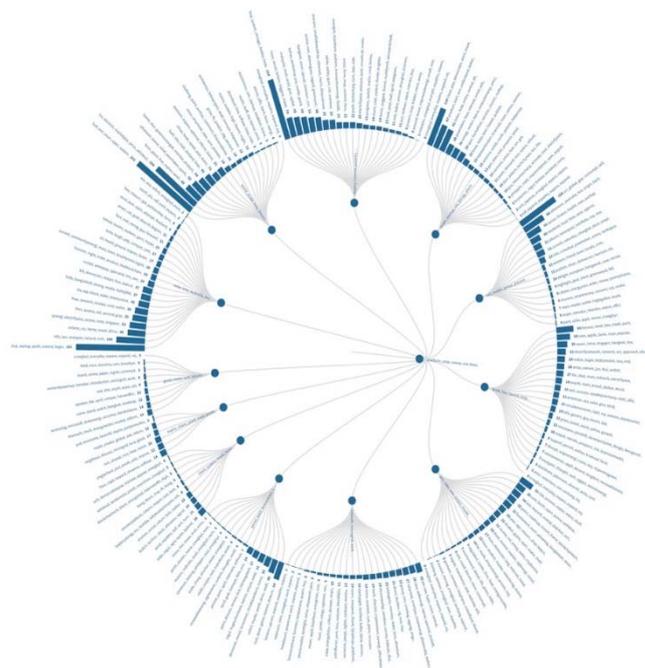


Figure 2. Visualisation of the hierarchical root topics

Though the hLDA model concerning feature engineering is a significant technique to understand the reasons for P2P energy trading, future study should compare two approaches, including Short Text Topic Modelling (STTM). Moreover, the hLDA model results suggests the professionals as well as experts' opinions as they are the ones primarily contributing to the P2P energy trading discussion. Although this can act as the study's limitation, it can also help in interviewing customers with previous trading experience to gain additional information, which is also the future approach of this study.

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A Switch on Electronic Commerce Mobile Payment: From Traditional Queuing to Elastic Request as a Payment Service Based on the Edge Computing Model

(Full Paper)

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ABSTRACT

The most common consumption payment problems are time delay, efficiency loss and poor experience caused by Queuing service congestion. This paper claims that a secure and highly efficient online mobile payment protocol is necessary. According to the special requirements of massive payment requests, high elasticity, high concurrency, high risk and instant response in mobile e-commerce, this paper propose an appropriate model for the application requirements of the service pattern for edge computing model-computing is service pattern, and the task model, computing model and service model provided by this pattern are abstracted. Finally, through LoadRunner load testing simulate request as a payment service model. Simulation results show that the construction of e-commerce retail payment network queuing model and mobile security payment protocol can solve the conversation of payment queuing efficiency and reduce waste of resources, and customers can enjoy safety payment experience.

Keywords: Queuing theory, mobile payment, edge computing, LoadRunner load testing.

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INTRODUCTION

Congestion is a common phenomenon in social life. Congestion, also known as congestion, is extremely common in discrete events, such as road traffic, telephone exchange, airport dispatching, medical treatment, railway Spring Festival travel tickets, supermarket payment, water and electricity payment, etc. This is not only a common social life phenomenon, but also an important field of economic research. From an economic perspective, congestion is caused by demand exceeding supply and scarce resources. In queuing, the most important reason for congestion is the currency payment caused by the use of goods and services, and the queuing problem caused by the completion of the transfer of currency ownership by both the supply and the demand. Because of universal existence in traditional retail sales, by increasing the physical counter and teller to reduce and eliminate the payment queue congestion, can cause appear alternately season settlement services in short supply and the off-season of clearing idle and waste of resources, the counter even in elasticity to the counter and teller resources optimization scheduling model cases.

LITERATURE REVIEW

In the study of queuing problem, as early as 1838, French mathematician Simeon D, Poisson (Land, McCall, & Nagin, 1996) studied the discrete probability distribution commonly seen in statistics and probability. Erlang studies the customer arrival density function (Fallah Nezhad & Akhavan Niaki, 2011), which is often used in telephone and communication system queuing. Jones and Peppiatt (1996) analyzed the relationship between actual queuing time and acceptable waiting time of customers in the service industry and verified it through empirical research. Baldinger and Rubinson (1996) established the queuing theory model to verify the effect of dynamic adjustment of service capacity on easing queuing congestion in the service industry. Houston, Bettencourt, and Wenger (1998) studied the relationship between customer queuing time and customer perception of service quality in the service industry. The above scholars all studied the payment settlement queuing problem in physical retail under the background of industrial economy based on the existence of physical settlement counters. Under the background of network economy, physical settlement counters have gradually evolved into network virtual payment (Mills et al., 2016), and mobile payment has become the inevitable direction of future payment development (Fan, Xu, & Wan, 2013). Therefore, the traditional queuing research has turned to network queuing and its solutions. On the basis of computer payment DES and RSA data encryption protocol (Forouzan, 2007), some scholars designed a authentication and payment protocol applicable to mobile environment in the improved Random Early Detection (RED) nonlinear algorithm (Zhang, Ma, Wang, & Chen, 2011). However, due to the large amount of computation of the protocol, the user's waiting time for payment is delayed, which can only be used for small payment. In order to reduce the computational load, some scholars proposed to construct a mobile phone payment system based on signature encryption algorithm (Floyd & Jacobson, 1993). Other scholars proposed to make up for the deficiency of transaction speed and security in the above mobile payment schemes by means of the third-party payment platform and the key distribution mechanism of "one key at a time" (Floyd & Jacobson, 1993). In order to improve the security of payment protocol. Xie (2008) proposed a compound payment protocol that can meet multiple security attributes.

Based on the traditional retail queuing line model, this paper extends it to e-commerce payment queuing and constructs the $M/M/n/m$ payment request queuing circle model. Furthermore, this paper propose an appropriate model for the application requirements of the service pattern for edge computing model, and service model provided by this pattern are abstracted. Finally, through LoadRunner load testing simulate request as a payment service model. Simulation results show that the construction of e-commerce retail payment network queuing model and mobile security payment protocol can solve the conversation of payment queuing efficiency and reduce waste of resources, and customers can enjoy safety payment experience.

Basic concept of physical retail payment queuing

Definition 1 A system consisting of one type of multiple services (desks) to provide certain services for random arrival consultants, and a system in which the customer views the server (desk) as "idle" or "busy" and is served or waited according to its queuing law is called queuing (service) system. Here, customer and waiter are generalized.

Discrete event system uses stochastic process theory and probability statistics to describe the main elements of retail event system: entity, event, activity and process. For this reason, the discrete system is represented as a logical set of external events (X) , output events (Y) , sequential states (δ) , output functions (λ) , and the logic set $M = (X, Y, S, \delta, \lambda, t_0)$ of the time advancement functions (t_0) .

Definition 2 In the retail trade customer and the waiter currency payment settlement queue as a queuing system, its basic structure consists of four parts including the input process (customer traffic), service time (business processing time, non-business processing time customer stop line, stop also provide payment services), service (service window settings) and queuing rules.

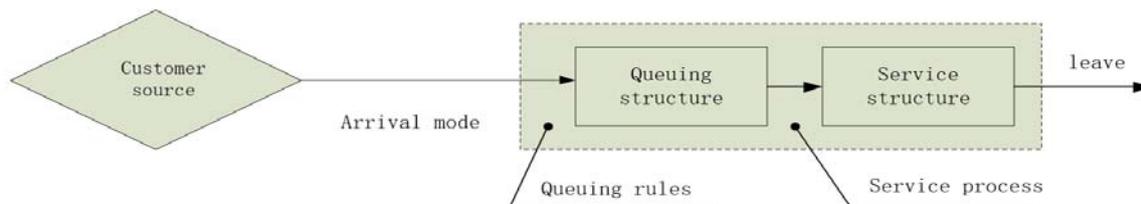


Figure 1: Composition of retail queuing service system.

Queued arrival mode

Describe the distribution pattern in which customers randomly come to the settlement counter in a retail store and request payment and settlement services. Arrival mode, also known as system input process, is represented by random arrival time. Common arrival modes include: constant length distribution, Poisson distribution, Erlang distribution, exponential distribution and super exponential distribution.

(1) Fixed-arrival distribution: the arrival of the entity (customer) in the equidistant time interval is the fixed-length arrival distribution, and the mathematical expression is

$$A_0(t) = p\{T \leq t\} = \begin{cases} 0, & t \geq a \\ 1, & t \leq a \end{cases} \quad (1)$$

(2) Poisson arrival distribution: an entity (customer) has an arrival probability within a given length of time. This is the typical arrival distribution in the payment queuing service system of the retail industry

$$p(n) = \frac{(\lambda t)^n e^{-\lambda t}}{n!}, \quad n = 0, 1, \dots \quad (2)$$

(3) Erlang distribution: often used in telephone and communication switching systems whose mathematical expression is

$$A_0(t) = e^{-k\lambda t} \sum_{n=0}^{k-1} \frac{(k\lambda t)^n}{n!} \quad (3)$$

k is a positive integer greater than zero.

(4) Exponential arrival distribution: is a universal arrival distribution, whose cumulative function is

$$F(t) = y = 1 - e^{-\lambda t} \quad (4)$$

If the random number y is uniformly distributed, it can be simplified as

$$t = \frac{-\ln(y)}{\lambda} = T_a \ln(y) \quad (5)$$

Where T_a is the mean mutual reaching time.

(5) Hyper exponential arrival distribution: this is a type of distribution where the variance is greater than the mean. It's main characteristic is that the data appears low value and high value more frequently. Generally, when the coefficient C_v of variation is greater than 1, the data can be fitted with a super exponential distribution. Distribution function is

$$A_0(t) = S e^{-2s\lambda t} + (1-S) e^{-2(1-s)\lambda t}, \quad 0 \leq S \leq \frac{1}{2} \quad (6)$$

$S = K T^2$ is the variance; $C_v = K^{\frac{1}{2}}$ is the coefficient of variation, where $K = \frac{(1-2S-2S^2)}{2S(1-S)}$

Queuing rules

A queuing rule is a rule that selects the next customer from the queue when the counter clerk completes the billing service for the current customer. Due to the randomness of customer arrival and service time, there are many queuing rules. The queuing rule is called the queuing law. Retail stores usually take First Come First Service (FCFS) law, or priority service such as VIP service law. If the captain exceeds N, the customers will leave automatically when they arrive later. When the customer's waiting time is longer, the customer will leave automatically.

Service organizations

The configuration of a certain number of service tellers and counter machines that provide settlement services to customers. Such as several service counters in parallel, serial, or other connection mode. Retail stores generally adopt single queue, single service counter system.

Service process

The service process that takes time to complete the settlement service for each customer. It describes the statistical characteristics of service processes and also has some distribution characteristics. It usually has the following distribution:

(1) Service time of fixed length distribution. All customer service hours are constant, denoted by D

(2) Negative exponential distribution of service time. Each customer service time $\frac{1}{\mu}$ is independent of each other and has the same negative exponential distribution. The M is the average service time.

(3) Erlang distributes service hours. If the service of customers must go through a series of K service counters, the service time T_i of each service counter is independent of each other and subject to a negative exponential distribution with a mean value of E_k .

(4) Service hours are generally randomly distributed. For example, service tellers may have different service time distribution, and the service time distribution depends on the team leader.

Physical retail payment queuing service system modeling

The basic mathematical model of payment, settlement and queuing in physical retail stores can be expressed as a $M|M|C$ model. The $M|M|C$ model represents a queuing system model in which the input process (customer arrival) is Poisson's input, service time obeys negative exponential distribution. The main quantitative indicators of the model can be expressed as:

Ls : Represents the number of customers in the system, including all customers waiting in line and being served (also known as the average captain).

Lq : Represents the number of customers waiting in line in the system (called the average queue length).

Tq : Represents the average waiting time of customers in the system (i. e. the average queuing time).

Ts : Represents the average customer stay time in the system (including waiting time and service time).

λ : Represents the average customer arrival rate (known as customer arrival rate).

μ : Represents the average service rate of the system (i. e. the average service rate of the service desk).

ρ : Represents service intensity, whose value is the ratio of effective average arrival rate λ to average service rate μ , i. e. $\rho = \lambda / \mu$.

The less the waiting time, the better the system performance. Obviously, this is something that customers and physical retail stores are very concerned about. Customers want to queue as short as possible. Similarly, for cashiers, the service intensity is as small as possible.

Model solution

Firstly, we discuss the situation $C = 1$, the model becomes $M | M | 1$, that is, the model represents the situation that there is

only one settlement counter, so $\rho = \frac{\lambda}{\mu}$, when $\rho < 1$. In other words, when the average number of customers arriving per unit time is less than the average number of customers served, the queue length can avoid infinite growth and reach

equilibrium. The probability of having a customer in the system at any given time t there are n customers is $P_n(t)$.

When the system reaches a stable state, the probability $P_n(t)$ tends to a stable state P_n , here P_n is not

related to t , the system is said to be in statistical equilibrium, also P_n is the steady-state probability under the

equilibrium state. It represents the probability that the system has n customers under the stable state, where $P_n = (1 - \rho)\rho^n$,

specifically $P_0 = 1 - \rho$ ($\rho < 1$).

The following expression can be obtained by using probability statistics:

(1) The average number of customers (average queue length) in the system Ls is:

$$Ls = \sum_{n=1}^{\infty} nP_n = \frac{\rho}{1-\rho} = \frac{\lambda}{\mu - \lambda} \quad (7)$$

(2) The average number of customers waiting in a queue (average queue length) Lq is:

$$Lq = \sum_{n=1}^{\infty} (n-1)P_n = Ls - \rho = \rho Ls \quad \left(Ls = \frac{\rho}{1-\rho} \right) \quad (8)$$

(3) The average customer stay time Ts in the system and the average wait time Tq in the queue are respectively:

$$Ts = \frac{1}{\mu - \lambda} = \frac{Ls}{\lambda} \quad Tq = Ts - \frac{1}{\mu} = \frac{Lq}{\lambda} \quad (9)$$

Secondly, we suppose that the average service rate of each billing counter is the same μ , at this time, the average service rate of the whole system is $C\mu$, so service intensity $\rho = \lambda / C\mu$, when $\rho < 1$, There is an equilibrium state in the system, and

the probability of the number of customers n in the steady-state system at any time is $P_n = P\{N = n\}$; especially when

$n = 0$, P_n is P_0 , P_0 represents the probability that all settlement counters in the steady-state system are empty (because the number of customers in the system is 0). According to queuing theory and probability statistics:

$$P_0 = \left[\sum_{k=0}^{C-1} \frac{1}{k!} \left(\frac{\lambda}{\mu} \right)^k + \frac{1}{C!} \left(\frac{\lambda}{\mu} \right)^C \frac{C\mu}{C\mu - \lambda} \right]^{-1} \quad (10)$$

At this point, the performance indicators of the model are as follows:

(1) Average queue length Lq is:

$$Lq = \sum_{n=C+1}^{\infty} (n-C)P_n = \frac{(C\rho)^C}{C!(1-\rho)^2} \rho P_0 \quad (11)$$

(2) Average queue length Ls is:

$$Ls = Lq + C\rho \quad (12)$$

(3) The average customer stay in the system Ts is:

$$Ts = \frac{Ls}{\lambda} \quad (13)$$

(4) The average time a customer waits in a queue Tq is:

$$Tq = \frac{Lq}{\lambda} \quad (14)$$

According to the above expression, as long as know the average arrival rate λ of customers in the system and the average service rate μ , the system can calculate the average customers waiting time to improve the quality of service, as shown in figure 2.

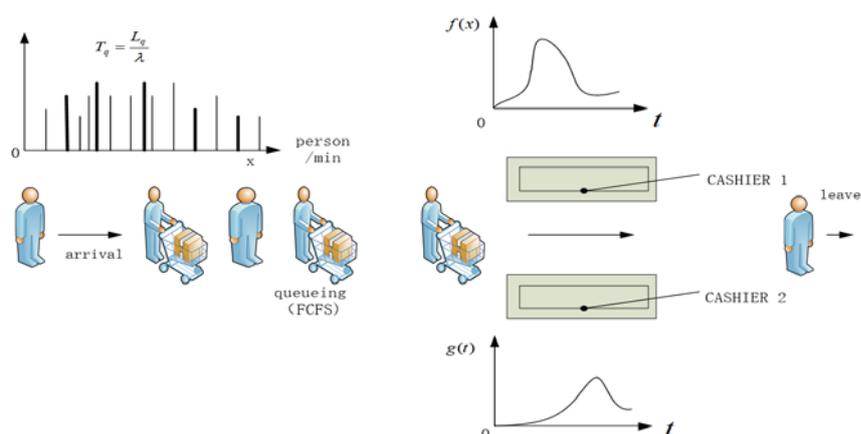


Figure 2: Linear system model of payment queuing in physical retail stores.

HYPOTHESES DEVELOPMENT

Modeling of e-commerce queuing payment

In e-commerce payment, the e-commerce platform does not need to provide customers with the necessary physical settlement counters and tellers in physical retail payment. Customers only need to send a payment request to the payment link page, and the payment system provides corresponding services according to the customer's request. The customer and the payment service provider can be regarded as queuing according to the circumference regardless of the distance between the spatial entity and the virtual space of the network. The customer and the payment service provider have the same space distance. The queuing rule is Along With the Service (AWS). The customers complete the whole payment process by himself. Its queuing model can be constructed as figure3.

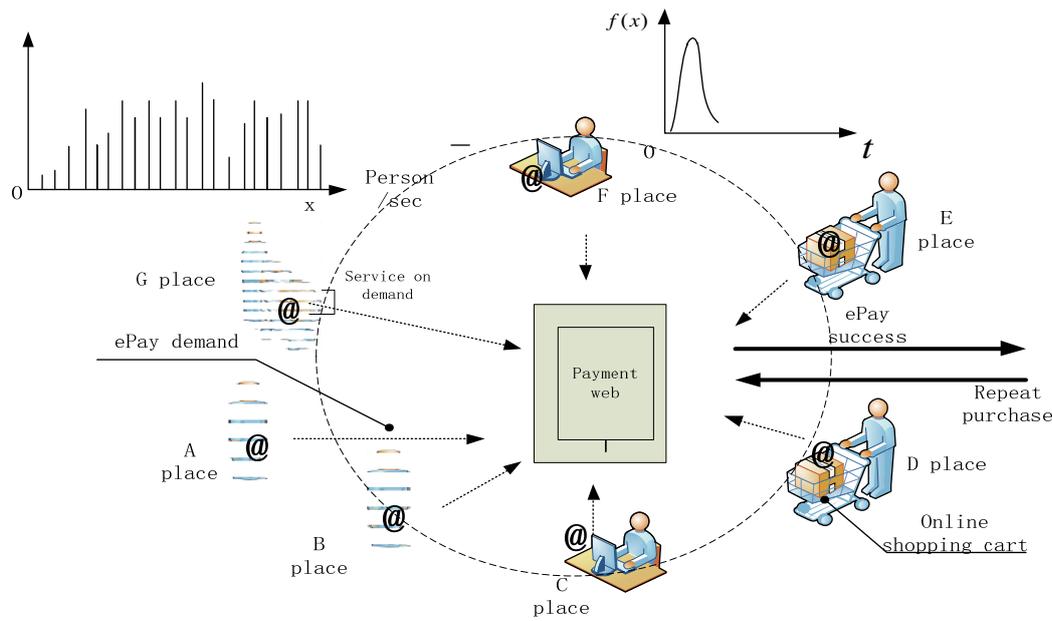


Figure 3: e-commerce payment queue circumference system model.

E-commerce payment queuing model solution

It is assumed that there are new service windows which can provide the required file access in the file list managed by the network payment node, and the payment requests made by users or connected to the payment node reach the system according to Poisson distribution, with the strength of λ . We suppose that each service time that can provide payment request obeys negative exponential distribution, and the intensity is μ . The characteristic of this model is that the payment page node can accommodate up to one user's payment request m , namely customer ($m > n > 1$). If the payment page node is full (that is, there are already m payment requests), the new payment page node request will immediately leave and find another payment page node to provide services. Obviously, there must be a place in the system for customers $m - n$ to wait in line.

So assume $n = 8, m = 12, \lambda = 10, \mu = 4, \rho_1 = \frac{\lambda}{\mu} = 2.5, \rho = \frac{\lambda}{n\mu} = 0.3125$

Then

$$p_0 = \begin{cases} \left[\sum_{k=0}^{n-1} \frac{(n\rho)^k}{k!} + \frac{(n\rho)^{m-n+1}}{1-\rho} \right]^{-1} & \rho \neq 1 \\ \left[\sum_{k=0}^{n-1} \frac{n^k}{k!} + \frac{n^n}{n!} (m-n+1) \right]^{-1} & \rho = 1 \end{cases} \tag{15}$$

$$p_k = \begin{cases} \frac{\rho_1^k}{k!} p_0 = \frac{n^k \rho^k}{k!} p_0 & 0 \leq k \leq n \\ \frac{\rho_1^k p_0}{n! n^{k-n}} = \frac{n^n \rho^k p_0}{n!} & n \leq k \leq m \end{cases} \tag{16}$$

(1) The probability of losing the payment request at the payment node is:

$$p_0 = \left[\sum_{k=0}^7 \frac{(2.5)^k}{k!} + \frac{(2.5)^8}{8!} \frac{1-(0.3125)^5}{1-0.3125} \right]^{-1} = 0.08263801$$

(2) The relative passage capacity of the payment node:

$$Q = 1 - p_m = \frac{n^m \rho^m}{n!} p_0 = \frac{8^8 (0.3125)^{12}}{8!} p_0$$

(3) The average number of requests per unit time to the payment node:

$$\lambda_e = \lambda(1 - p_m) = \lambda Q = 9.99970383$$

(4) The average queue length of a payment request queued at the payment node:

$$L_q = \sum_{k=n}^m (k-n) p_k = \sum_{k=8}^{12} (k-8) p_k = 0.001979834$$

(5) The average queue length of the payment request waiting at the payment node:

$$L_s = L_q + L_{\text{服}} = L_q + \frac{\lambda_e}{\mu} = 2.501905792$$

(6) According to little formula, the average stay time and average queuing time of the payment request at the payment node can be obtained:

$$W_s = \frac{L_s}{\lambda_e} = W_q + \frac{1}{\mu} = 0.250197989$$

$$W_q = \frac{L_q}{\lambda_e} = 0.000197989$$

E-commerce queuing mobile payment initial assumption

(1) Merchants and Banks have their own digital certificates.

(2) The customer and the merchant have registered with the bank, and the customer and the merchant have their own accounts ID_x .

(3) Customers and merchants trust the bank.

(4) A series of safe and efficient pseudo-random numbers can be generated between the customer and the bank through a common initial seed, which has been deposited in the mobile phone when the customer registers in the bank. Registered in the bank according to the assumptions, customers via secure off-line methods set up efficient pseudo-random number generator cyclic shift and hash function operation, can produce a series of pseudo-random number PRN_i . Each pseudo-random number is based on a pseudo-random number.

Definition:

C , M , B : Represent customers, businesses and Banks respectively.

ID_x : Identity includes all information of X .

DC_x : Digital certificate X .

PK_x : Public key X .

SK_x : Private key X .

PSW : Client's banking login password.

$E(msg)K$: Symmetric encryption computation on msg with a confidential key K .

$H(msg)$: Hash the message msg .

Signx (msg) : Sign the message msg using the key K .

TID : Transaction characteristics including time and date.

OI : Order information = $OI = \{TID, OD, Price, Description\}$, here OD means the type and quantity of the order, $Description$ represents the description of the digital product ordered.

PAY : Payment information, including the account number of the transfer and the payer's own account information.

$PAY = \{TID, Price, Account_C, Account_M\}$.

PRN_i : The initial seed produces the i^{th} in a series of pseudo-random numbers.

$Y_{M,C}$: Shared key between merchant and customer.

\otimes Exclusive or operation.

Payment protocol

When the price of goods or services has been negotiated between the two parties to the transaction, the customer initiates a payment request. If one party does not receive a reply within the specified time, the agreement shall be terminated. The payment procedure is as follows:

Step1 $C \rightarrow M$

$$ID_C, ID_M, OI, i, HASH(ID_C, ID_M, OI, i), PRN_i \otimes PRN_{i+1} \otimes PSW \quad (17)$$

The customer initiates a payment request to the merchant, and the request message includes the identity information of the customer and the merchant, the order information and the corresponding integrity authentication information. Finally, the authentication information of the customer to the bank is attached, which generates two pseudo-random numbers and the difference or result between the bank login password for the customer offline. The main purpose of using two pseudo-random numbers for exotic operation is to prevent the user password from being guessed correctly and revealing the pseudo-random number information.

Step2 $M \rightarrow B$

$$E \left\{ \text{Sign}_{SK_M} \left\{ ID_C, ID_M, i, PRN_i \otimes PRN_{i+1} \otimes PSW, PAY, Y_{M,C}, E \{ ID_M, OI \}_{Y_{M,C}} \right\}, DC_M \right\}_{PK_B} \quad (18)$$

After receiving the payment request from the customer, system will check the order information and verify its integrity. After confirmation, it will send the transfer request message to the bank. The content of the message includes the identity information of the customer and the merchant, the digital certificate of the merchant, the account information, the authentication information forwarded by the customer to the bank, the Shared key generated by the merchant for the transaction with the customer and the identity and billing information encrypted with the shared key. The transfer request message is signed with the private key of the merchant and then encrypted with the public key of the bank to ensure the security and non-repudiation of the message.

Step3 $B \rightarrow C$

$$PRN_{i+2} \otimes PRN_{i+3} \otimes E \{ ID_M, OI \}_{Y_{C,M}}, PRN_{i+4} \otimes PRN_{i+5} \otimes PAY, PRN_{i+6} \otimes PRN_{i+7} \otimes Y_{C,M} \quad (19)$$

After the bank receives the customer authentication information forwarded by the merchant, it compares whether the value of I is consistent with its pseudo-random sequence. If consistent, the corresponding pseudo-random number PRN is generated. The

authentication message is exotic calculated with PRN_{i+1} to obtain the login password PSW. If the calculated PSW is inconsistent with the original password, the protocol terminates and a short message notifies the client to proofread. If the pseudo-random number, customer identity information and login password correspond, then the authentication. After confirming the customer information, use two pseudo-random numbers for the account information forwarded by the merchant, the shared key, and the order information encrypted with the shared key PRN_{i+2} to PRN_{i+7} , perform exotic encryption. The bank will send the above information to the customer and wait for the customer's final confirmation.

Step4 C→B

$$PRN_{i+8} \otimes PRN_{i+9} \otimes E\{ID_C, OI\}_{Y_{C,M}}, PRN_{i+10} \otimes PRN_{i+11} \otimes PAY \quad (20)$$

After the customer receives the confirmation information sent by the bank, the corresponding pseudo-random number is generated from PRN_{i+2} to PRN_{i+7} and perform exotic operation to obtain the account information and the shared key information with the merchant, and then use the shared key to unlock the encrypted order information. After the confirmation of the customer, two pseudo-random numbers from PRN_{i+8} to PRN_{i+11} , express customers' confirmation and agree to transfer. The transaction is terminated if the customer receives an objection to the information.

Step5 B→M

$$E\left\{Sign_{SK_B}\left\{E\{ID_C, OI\}_{Y_{C,M}}, PAY\right\}, DC_B\right\}_{PK_M} \quad (21)$$

After the bank receives the confirmation information sent by the customer, the corresponding pseudo-random number is generated from PRN_{i+8} to PRN_{i+11} . Notify the merchant that the transfer is successful. If the bank fails to receive the confirmation of the goods within the stipulated time, the transaction will be terminated.

METHODOLOGY

Elastic request as a payment service model

In recent years, the computing workload of e-commerce mobile payment task has been migrating, first from the local data center to the cloud, and now increasingly from the cloud data center to a location closer to the data edge. The purpose of doing this is to solve the problem faced by cloud computing: the linearly growing centralized cloud computing ability cannot adapt to the rapid growth of massive edge data, especially the massive centralized mobile payment requests and sudden growth, which makes the network edge devices transmit a large amount of data to the cloud computing center. At the same time, limited power network edge devices will consume a lot of power when they transmit data to the cloud computing center. Moreover, the personal privacy problem of network edge data is particularly prominent, which makes the core payment data in e-commerce have the risk of being eroded.

The key elements in the task model include time delay, bandwidth utilization, context awareness, generality and elastic computing power. Although the development of accurate models is very complex for tasks, for edge computing models, mathematical optimization allows simple tasks to meet the requirements of zero delay, zero error and zero leakage. The following are two commonly used calculation task models.

Task model of binary transfer

Highly integrated or relatively simple tasks cannot be partitioned, and must be performed as a whole in the edge device or transferred to the edge computing center server for processing, which is called binary transfer. Such task can be represented as (L, TD, x) by three symbol field, which contains the following information: task input data size L (in bit), completion period TD, calculation workload x (in CPU clock period). The use of these parameters can not only capture the basic properties of the edge device processing tasks, but also facilitate the simple evaluation of execution delay and the estimation of energy consumption performance.

Task (L, TD, x) needs to be completed before the hard deadline TD. This model can also be extended to deal with the soft deadline requirements, allowing tasks with large amount of data to be completed later. In this case, the computational effort required to perform the input data of the 1 bit task is modeled as the random variable x.

In practice, many edge tasks are composed of many subprocesses, which makes it possible to transfer each subprocess to local edge devices for execution, so as to achieve fine-grained task transfer. Specifically, the task can be divided into two parts: one

is the task processed by the edge device itself, the other is the task performed by the edge device or the edge computing center which is closer to the device, or it can be coordinated by the edge computing center.

The simplest task model for local transfer is the data partition model, in which task input is bit independent. This task model can be arbitrarily divided into different groups, which can be implemented in different entities under the edge computing system. However, there are obvious dependencies between different processes or components. How to deal with these dependencies will significantly affect the efficiency of execution. There are two key problems:

(1) The execution sequence of functions or routines, because the output of some processes or components is the input of other processes or components, the control of execution sequence is the guarantee to realize the correctness of local transfer.

(2) Due to the limitation of the software and hardware of the edge devices, at present, we can only achieve isomorphic transfer, and cannot transfer the task to the heterogeneous devices. The abstraction of the software and hardware of the edge devices is the guarantee to achieve the maximum utilization of the local transfer.

CPU performance is represented by CPU cycle frequency f_m (CPU clock speed). The architecture of edge computing equipment adopts Dynamic Frequency and Voltage Scaling (DVFS). It can adjust the energy consumption by changing the cycle frequency of CPU. In practice, f_m is limited by the maximum f_{CPU}^{\max} (the maximum computing power that edge devices can provide). In combination with above mentioned task model A (L, T_d, x) introduced in the previous section, the delay of the model can be evaluated with the following formula:

$$t_m = \frac{LX}{f_m} \quad (21)$$

Among them, $f_m \leq f_{CPU}^{\max}$

Equation (21) reflects the delay t_m affected by the computing performance. f_m represents the computing power possessed by the edge device. When the content of LX processing is certain, the delay of the system can be adjusted by adjusting f_m . Increasing f_m can reduce the delay, but decreasing f_m will increase the delay. According to the CPU energy consumption, f_m reflects the energy consumption. Therefore, edge devices need to allocate energy consumption and delay reasonably. When low latency is needed to ensure the real-time performance of tasks, f_m can be appropriately increased; otherwise, when low power consumption is needed to ensure the energy-saving performance of tasks, f_m can be appropriately reduced. DVFS is the key technology to provide this capability, which is an elastic request as a payment service model.

According to the service characteristics of edge computing devices, two widely used service models are abstracted according to the requirements of low latency and low energy consumption.

Sequential service model

As shown in Figure 1, the model is mainly for services with clear sequence requirements. Each node is represented by $e(i, j)$, and the subscript i represents tasks in different stages. The subscript j only represents the node number that jointly completes j tasks at the same time as the subscript i . The node is characterized by isomorphic architecture. The advantages of this model: it can provide different services according to different users, making the service more user-friendly; the same tasks with subscript i can provide low latency services according to binary transfer or local transfer task model; it can increase or reduce the number of j by DVFS technology according to the requirements of service delay, with flexible structure and maximum utilization of energy consumption. The following presents the delay t_{total} (minimum delay time) and energy consumption E_s (minimum energy consumption) model of the structure:

$$t_{total} = \min_{1 \leq i \leq n, 1 \leq j \leq m} \sum_{i=1}^n \frac{L_i X_i}{\sum_{j=1}^m f_j} \quad (22)$$

Therein, $n \in Z^+, m \in N^+, f_j \leq f_{CPU_j}^{\max}$

$$E_s = \min_{1 \leq j \leq m} \sum_{j=1}^m f_j \quad (23)$$

Therein, $m \in \mathbb{Z}^+$, $f_j \leq f_{CPU_j}^{\max}$

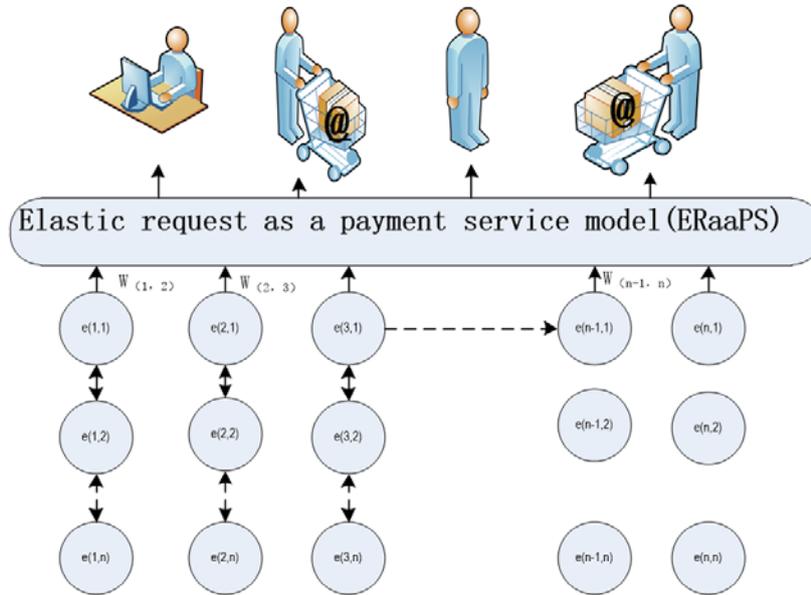


Figure 4: Sequential Service Topology after Row Arrival Model.

Central service model

As shown in Figure 4, the model is mainly for services without clear sequence requirements. Each node is represented by e_i , and the subscript i represents the node number under the structure. The model has two central nodes, such as e_1 distribution center node and e_2 collection center node. According to the current status of e_i ($i \neq 1$, $i \neq n$), the distribution center node will be assigned to different nodes for execution according to the task characteristics; the collection center node will provide the execution results of e_i ($i \neq 1$, $i \neq n$) to users after sorting. The advantages of the model: the distribution center node coordinates tasks, can handle multiple tasks in parallel, and meet the real-time requirements; the aggregation center node provides services, unified external interface, and provides more friendly services; each node has a clear division of labor, and can maximize the use of limited computing resources of edge devices. The following presents the delay total (minimum delay time) and energy consumption E_s (minimum energy consumption) model of the structure:

$$t_{total} = \text{MAX}_{1 \leq i \leq n} \frac{L_i X_i}{f_i} \quad (24)$$

Therein, $n \in \mathbb{Z}^+$, $f_i = f_{CPU_i}^{\max}$

$$E_s = \text{MAX}_{1 \leq i \leq n} \sum_{i=1}^m f_i \quad (25)$$

Therein, $n \in \mathbb{Z}^+$, $f_i = f_{CPU_i}^{\max}$

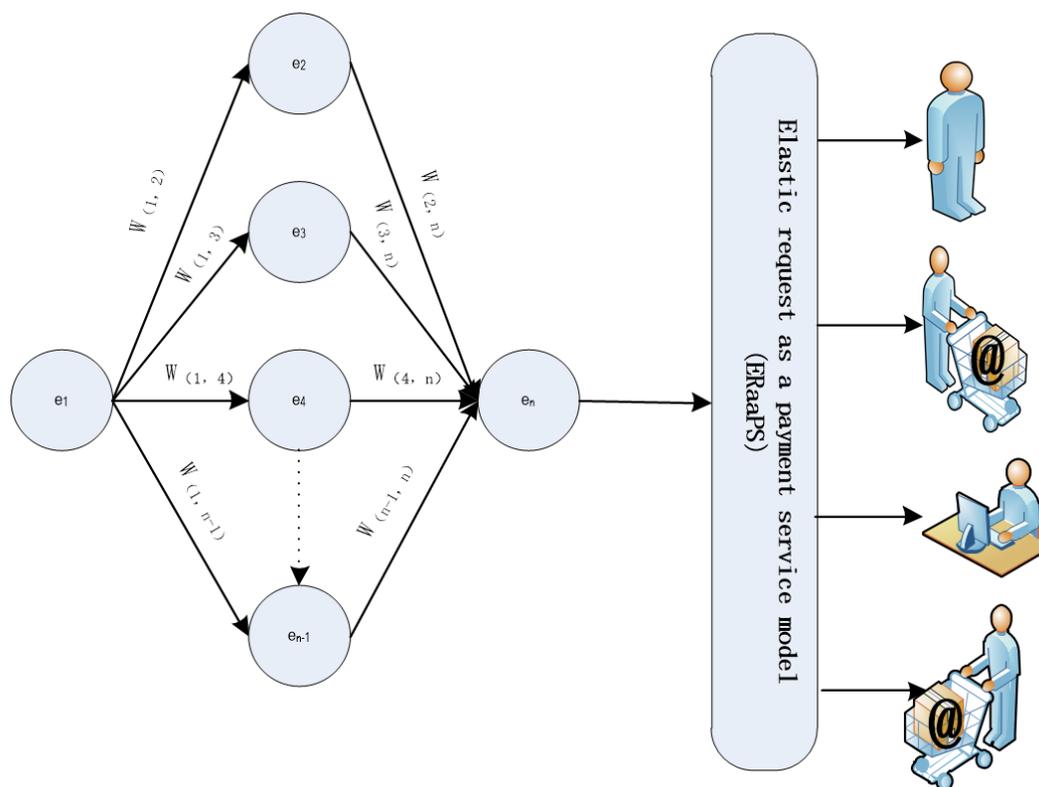


Figure 5: Service model of central topology.

DATA & RESULTS

E-commerce payment system LoadRunner load test target

LoadRunner is a kind of suitable for all kinds of architecture of the automatic load test tool, which implements real-time performance monitoring for the system under test at the same time, and automatically generate test results. Its purpose is to put the e-commerce payment in the simulation environment to test the performance of the system: predict the load of the system under pressure, analyze and evaluate the bottleneck of the system, and optimize the system performance before the release of the system. The test content includes: (1) average response time of access; (2) the maximum response time of access; (3) average number of access per second processing; (4) the success rate of access users; (5) the above record value under the condition of different concurrent users.

Load test steps for e-commerce payment system LoadRunner

Run the Controller of LoadRunner, select the recorded script, set the number of virtual users and run it. When running, the number of virtual users set (the initial number of users is 100, 100 users are added each time) will be the number of concurrency, and the website will be accessed concurrently. It is preliminarily estimated that the maximum concurrency of the payment webpage will be 500 users. Then, all kinds of important index data of system performance were recorded, and the resource occupancy of the system was concerned. Then, test results were analyzed and experimental conclusions were drawn.

(1) Average Transaction Response Time

Table 1 Average Transaction Response Time

Color	Scale	Measurement	Min.	Ave.	Max.	SD
Red	1	Action_Transaction	238.022	238.084	238.166	0.03
Yellow	1	Action1_Transaction	9.019	9.06	9.123	0.021
Blue	1	vuser_emi_Transaction	0.0	0.0	0.0	0.0
Green	1	vuser_init_Transaction	0.0	0.0	0.0	0.0

Results: table 1 shows the minimum average transaction response time: 9.019 average 9.06

Maximum: 9.123 average transaction error: 0.334.

Analysis: transaction response time <2s is in an excellent state.

2s ~ 10s good condition.

It fails when it's greater than 10s.

From the results, it can be analyzed that the average response time of things is greater than 2s and less than 10s in a good

state.

Table 2 Payment client system resource calls

Color	Scale	Measurement	Min.	Ave	Max.	SD
Red	0.01	%Disk Time (Physical Disk Total) : localhost	0.15	50.367	4145.203	295151
Yellow	0.01	File Data Operations/sec (System) : localhost	12	114.145	6211.403	475.231
Blue	0.01	Page Faults/sec (Memory) : localhost	1028	1795.227	12324.25	1107.642
Green	0.1	Pages/sec, e (Memory) : localhost	0.0	7.054	278.008	36.35
Purple	1E-6	Pool Nonpaged Bytes (Memory) : localhost	34750464	35035412.757	35323904	162161.285
Cyan	1E-7	Private Bytes (Process Total) : localhost	745607168	756772956.252	794722304	4346259.482
Black	10	Processor Queue Length (System) : localhost	0.0	1.072	8	1.191
White	0.1	Threads (Objects) : localhost	885	905.833	928	11.192

(2) CPU utilization Processor / %Processor Time

Results: according to table 2, the minimum CPU utilization value was 0.260%, the average value was 2.266%, the maximum value was 10.156%, and the error was 0.8660/.

Analysis: the average CPU utilization tested by this system is in an excellent state around 2.26%.

(3) CPU time consumed by database operation: Processor / %User Time.

Results: as can be seen from table 2, the minimum CPU time consumed by database operation is 1.367%, the maximum is 5.280%, and the error is 0.591%.

Analysis: more than 90% of the CPU consumed by database operation is in a relatively large state, so the optimization of the database system can be considered.

According to the results, the average CPU consumption of database operation is about 1.376%, and no optimization is needed.

Results: as can be seen from table 2, the minimum, average, 1.153%, maximum, 2.344%, and error: 0.8440/.

Analysis: the value of this parameter has been high, indicating that I/O is problematic. According to the results, the average CPU utilization is in a normal state.

(4) Remaining available Memory/Available Mbytes

Results: as can be seen from table 2, the minimum value of remaining available memory is 3064.000, the average value is 3067.678, the maximum value is 3070.000, and the error is 1.735.

Analysis: if the remaining available memory is less than 10%, the system memory may leak. As the physical memory of the machine is 4193Mb, the remaining available memory is $3067/4193 >$ and 100% meets the standard.

(5) Download pages per second Memory/pages/ SEC

Results: according to table 2, the minimum number of pages downloaded per second is 0.0, the average is 43.071, the maximum is 351.990, and the error is 125.789.

Analysis: CPU per second 0 page exchange for good, 10 bad, more than 10 is very poor.

The results show that the number of pages downloaded per second is poor.

Conclusion: in the above design of mobile payment system, mobile terminals only need to carry out active communication twice, which not only reduces the communication burden of mobile terminals, but also accelerates the processing speed of mobile payment. Therefore, it is more suitable for mobile payment business.

CONCLUSIONS

In this paper, based on the traditional retail queuing linear model, the research scope is extended to e-commerce payment queuing, and the payment request queuing circumference model $M / M / n / m$ is constructed. The traditional retail payment queuing mode and cloud computing model of e-commerce payment service mode have been unable to adapt to the demand of elastic response, zero delay, zero error and low power consumption. The edge computing mode is mainly reflected in the limited resources of edge equipment, the real-time service and the intelligent decision-making. In this study, firstly, from the traditional queuing model to the circle model, then to the edge computing model, the task model, computing model and service model of elastic demand payment service are abstractly modeled. According to whether the tasks are sequential or not, this paper presents two common elastic demand service models (sequential service model and central service model) of payment service, and gives the corresponding evaluation formulas of delay and energy consumption. Then, it uses LoadRunner which is suitable for various architectures to simulate massive end-users' simultaneous request for payment service load test evaluation and detection its response time, transaction rate and system stability prevent the payment system from queuing congestion or even collapse. The simulation results show that the service model of elastic demand payment service can effectively solve the problems of elastic demand, uneven server load, delayed payment time, and good customer payment experience.

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An Examination of Barriers to the Adoption of Smart Living Services: A Case Study of the Al-Madinah Region Development Authority

(Full Paper)

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ABSTRACT

The Middle East region is undergoing significant changes due to the growing number of people migrating to the cities. This has influenced the growth of progressive smart city initiatives and agendas, which seek to improve the quality of people's lives using technology-enhanced services. From health care to transportation, platforms to support smart living services are being developed and promoted as part of these efforts. Thus far, there has been slow adoption of these new technologies. This paper explores why people resist the very technologies that are being created to improve their lives. We use innovation resistance theory to examine functional barriers that hinder the adoption of smart living services in Saudi Arabia, in order to help inform the policy and marketing efforts of governments seeking to establish smart cities.

Keywords: Barriers to innovation, Innovation resistance theory, Middle East, Smart living services.

INTRODUCTION

The growth of and interest in the establishment of smart cities has reached significant levels in the Middle East. According to researchers, at least 11 of the 17 countries in the region have begun planning or implementing agendas for smart city development to support growing populations (Maheswaran & Badidi, 2018; Misbahuddin et al., 2015; Washburn et al., 2009; Zahran, 2013). Over €107 billion are being poured into these efforts (Fint, 2017; Pan, 2018) but there is significant consumer resistance that should be of concern to those promoting smart cities. By examining the types of services being offered to customers, we can better understand why these consumers are not using the health, energy, entertainment, and surveillance technologies necessary for cities to be 'smart'.

This study considers people's views on the smart living services that are available to them, in order to identify reasons for some individuals choosing not to use them. By examining the reasons for the lack of interest in, or awareness of, smart living services (W. Keijzer-Broers, Nikayin, & De Reuver, 2014), this study will contribute to helping Middle Eastern countries build better cities and related amenities.

Research into smart living services adoption is vitally important to national and regional agendas that seek to diversify oil-based economies. Use of technology is seen as an opportunity to do so, since the data that can be gathered can be used to build new devices and platforms for smart living services. Strategic decision makers in Middle Eastern nations want to ensure they can continue to enhance the quality of life for all by providing a high level of services. However, acceptance of emerging information and communications technology (ICT)-based applications by citizens in the Middle East faces a profound challenge (Aldraehim, 2013; Alshehri, Drew, Alhussain, & Alghamdi, 2012; Khan, Woo, Nam, & Chathoth, 2017). One of the biggest challenges to acceptance is the adoption rate of the new technologies (Almuraqab & Jasimuddin, 2017; A. Baabdullah, Dwivedi, & Williams, 2013; A. M. Baabdullah, Alalwan, & Al Qadi, 2018).

The adoption rate of new smart technologies is a topic within smart living research that requires more exploration. This paper examines barriers to the adoption of smart living services and identifies issues that are critical to technology innovation and policy. The goal of this paper is to examine the challenge in increasing the adoption of smart living services, using innovation resistance theory to explore functional and psychological barriers. The results of a five-month case study conducted in Madinah, a major city in Saudi Arabia, suggest that the resistance to certain types of barrier goes beyond the two established in the literature (i.e., functional and

psychological obstacles). These results are unique and impactful and contribute to the knowledge needed for smart cities to function as required.

LITERATURE REVIEW

This section presents research from the smart living literature, highlighting and discussing barriers to usage with a focus on smart living services (W. Keijzer-Broers & de Reuver, 2016). Innovation resistance theory provides a lens through which to examine how smart living products and services are made available, by focusing on where they have not been widely adopted. According to Nikayin and De Reuver (2015), lack of adoption presents a problem for financial decisions made by governments investing in building smart cities.

Smart Living and its Services

The rapid evolution of innovations in ICT and the internet of things (Vanston, Elliott, Bettersworth, & Caswell) (Vanston et al., 2006) for smart cities has created opportunities to enhance many people's quality of life, which is considered to be one of the main goals of the smart city agenda (Skouby, Kivimäki, Haukiputo, Lynggaard, & Windekilde, 2014). This goal is directly linked to the ICT/IoT platforms that enable smart living and is one of the six smart city characteristics (Giffinger & Pichler-Milanović, 2007). This is called smart living (SL), the area of focus in this paper.

Smart living is a trend that encompasses advancements that give people the opportunity to benefit from new ways of living (Riva-Mossman, Kampel, Cohen, & Verloo, 2016). The SL vision is to improve a population's quality of life and facilitate individuals' personal comfort (Nikayin, Skournetou, & De Reuver, 2011). Therefore, smart living services (SLS) are regarded as "mediators between providers and customers in the process of value creation" (W. J. Keijzer-Broers, Florez-Atehortua, & de Reuver, 2015, p. 2). These services are able to achieve the SL vision (Nikayin & De Reuver, 2011) by providing several ICT-enabled services linked with the IoT (Sudha Ram, 1987; Vanston et al., 2006). In leveraging ICT, SLS are capable of enhancing the quality of life for the inhabitants of a smart city (Chen, 2012). However, if the inhabitants of smart cities do not use the SLS, the smart city value chain is broken and the value delivery fails (Dameri, Benevolo, Veglianti, & Li, 2019). Therefore, it is clear how important SLS are to the success of a smart city in improving the quality of life of its population.

The pursuit of research into SLS is a recent trend in the information systems domain because many view this topic as part of the United Nations (UN) sustainability goals and associated with social science research. SLS is a term used in research to refer to technology which is "applied to daily life to increase efficiency, affordability, and sustainability" (C.-K. Lee et al., 2011, p. 93). SLS are also seen as being capable of creating an urban environment able to "offer advanced and innovative services to citizens in order to improve the overall quality of their life" (Piro, Cianci, Grieco, Boggia, & Camarda, 2014, p. 1). However, the use of SLS should not be restricted to users and residents within the home; individuals should also be able to take advantage of external information in order to consider a range of novel service concepts (Nikayin & De Reuver, 2011).

Such opportunities can result in increased motivation for service providers from different industry sectors (e.g., energy, security, telecommunications, and health) to become interested in offering SLS (W. J. Keijzer-Broers, de Reuver, & Guldmond, 2013, p. 1). In this way, multiple actors, "sometimes from different industries, pool their resources and capabilities to create and capture value from new services and products" (Solaimani, 2014, p. 12).

SLS are increasingly being exploited by city governments, "changing the ways to interact with citizens and providing novel and interactive services" (J. Lee & Lee, 2014, p. 94). SLS are commonly provided to consumers living in smart areas via sector-specific service platforms. A service platform is used to "host a set of core functions (e.g., data storage, processing power, intelligent decision-making components)" and service suppliers deploy these platforms to create, run, and deliver value-added services to consumers (Nikayin & De Reuver, 2012, p. 19). In short, to achieve that vision, smart living provides several ICT-enabled services, such as those that gather the value drivers of health, energy, security and entertainment (Agahari, 2016).

Many of the current benefits accrued from these types of new technology involving enabled and enhanced services are considered to be 'just' an innovation or fad (Mani & Chouk, 2018), with implications for diversification and development. Evidence suggests that consumers may perceive SLS (smart homes, smart healthcare, smart grids, smart banking, etc.) as something new and different. Consequently, the view of SLS in this paper is as a form of social innovation that brings together tech-enabled environments for daily living. The perspective that is taken in this paper is that SLS are critical to sustaining a smart city, presenting a challenge for

sustainability, new business development, and improved quality of life for the Gulf State region. The next section describes barriers to the use of SLS to understand better why consumers resist the new technologies.

Barriers to Smart Living Services

In order to ensure the maximum benefit from SLS, it is necessary to make sure that smart living is optimally adopted. This study examines the barriers to adopting smart living services. As people become more accustomed to adopting and using SLS, data can be collected and then used to assist with urban planning and in overcoming various technological and regulatory challenges (Wilson, Hargreaves, & Hauxwell-Baldwin, 2015). Despite smart living explicitly promoting users' quality of life, SLS, although technologically feasible and acceptable (W. Keijzer-Broers, Florez-Atehortua, & de Reuver, 2016), are faced with a number of challenges, which include the following:

- Lack of awareness among end users, to market commercialisation, to end-user acceptance, as to resistance.
- Lack of awareness of what SLS are and what is available as part of these services (W. Keijzer-Broers et al., 2016).
- Lack of knowledge of how these types of services can fulfil user needs (W. Keijzer-Broers et al., 2014).
- Markets for these services also struggle as a result of a lack of appropriate market structures (Good, Ellis, & Mancarella, 2017), market mechanisms (Cappers, MacDonald, Goldman, & Ma, 2013), and market regulation (Nikayin & De Reuver, 2012).

These challenges hamper the adoption and widespread use of SLS (Balta-Ozkan, Davidson, Bicket, & Whitmarsh, 2013). At a higher level, according to Sundaresan Ram and Sheth (1989), two fundamental barriers emerge that cause resistance to innovation in general. Those barriers are generic to resistance to various types of innovation and are categorised as functional and psychological. Functional barriers include usage, value, and risk barriers, whereas psychological barriers are linked to traditional and image barriers associated with use. Later SLS researchers argued that information, technology, and system barriers were consistent with certain functional barriers and institutional barriers aligned with psychological barriers. However, a review of the literature suggests that research that focuses on barriers that inhibit the use of smart living services is limited, which indicates that this area is in need of further investigation (Balta-Ozkan et al., 2013; Nikayin & De Reuver, 2015). This study seeks to explore further the barriers preventing people using SLS, with a focus on innovation resistance theory as a means of analysing a case study.

A View of Innovation Resistance Theory (IRT)

The reasons for consumers not adopting innovation are not always clear in the existing literature. IRT describes resistance “by consumers to changes imposed by innovations” (Sudha Ram, 1987, p. 208) during new product adoption. Resistance can also arise due to “fears that a product could be dysfunctional or malfunctional” (Joachim, Spieth, & Heidenreich, 2018, p. 97). Sundaresan Ram and Sheth (1989) first explained that consumers face various barriers that limit their desire to accept innovation. Furthermore, these barriers are more likely to appear once consumers perceived considerable change as a consequence of adopting the innovation (Sundaresan Ram & Sheth, 1989). Barriers were then classified into the following two categories: functional barriers and psychological barriers (Figure 1).

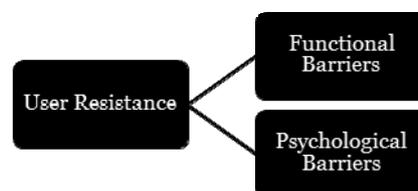


Figure 1: Types of barriers to innovation (Ram & Sheth, 1989)

Functional barriers are more likely to occur when a consumer perceives a significant change during a new product adoption (Ng, Lim, Lim, Ng, & Tan, 2013). According to Sundaresan Ram and Sheth (1989), functional barriers are directly related to three areas of the innovation itself:

- usage patterns, which may give rise to usage barriers to a new innovation;
- the value of the product or service; and
- risks associated when adopting the product or service (see Figure 2).

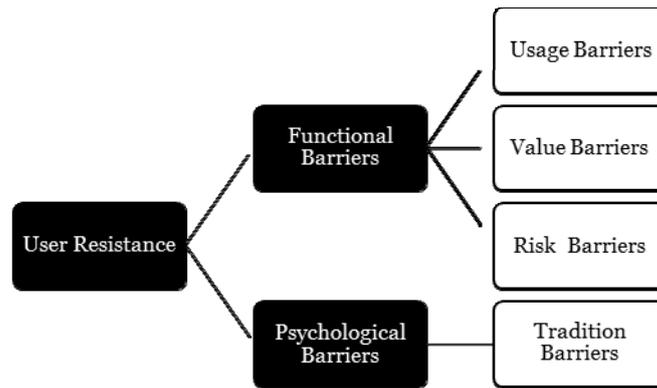


Figure 2: Innovation resistance theory (Ram & Sheth, 1989)

Psychological barriers emerge once an innovation conflicts with a consumer's social norms, practices, or individual usage patterns (Kleijnen, Lee, & Wetzels, 2009). These barriers are related to tradition (daily routines) and image (brand and product category) (Mani & Chouk, 2018). They come from traditional views, perceptions, and image views (Figure 2).

The two types of barrier are common to different types of innovation and are not specific to innovations in smart living services. However, as mentioned earlier, functional barriers can include usage, value, and risk barriers, whereas psychological barriers are associated with tradition and image barriers (Table 1).

Table 1: Types of barrier to innovation

Barriers		Definition	Sources
Functional Barriers	Usage barriers	Resistance towards a new invention due to its incompatibility with present routines, exercises, and plans.	Barati and Mohammadi (2009); Lian and Yen (2014); Lunsford and Burnett (1992); Moorthy et al. (2017); Sundaresan Ram and Sheth (1989); Rotchanakitumnuai and Speece (2003).
	Value barriers	Resistance towards the usage of products or services when they do not fulfil the user's perception of performance-to-price value in contrast with other substitutes.	Fain and Roberts (1997); T. Laukkanen, Sinkkonen, Kivijärvi, and Laukkanen (2007); Lian and Yen (2014); Moorthy et al. (2017); Sundaresan Ram and Sheth (1989); Rammile and Nel (2012)
	Risk barriers	Uncertainty regarding the possible negative consequences of using a product or service.	Lian and Yen (2014); Marett, Pearson, Pearson, and Bergiel (2015); Sundaresan Ram and Sheth (1989)
Psychological Barriers	Tradition barriers	The cultural change created for the customer by the innovation.	Cruz, Barretto Filgueiras Neto, Munoz-Gallego, and Laukkanen (2010); Hoeffler (2003); Joachim et al. (2018); Sundaresan Ram and Sheth (1989).
	Image barriers	The degree to which an innovation is perceived as having an unfavourable image.	Antioco and Kleijnen (2010); Chauhan and Choudhary (2018); Claudy, Garcia, and O'Driscoll (2015); Herbig and Day (1992); Talke and Heidenreich (2014).

Usage barriers have been defined as resistance towards a "new invention due to the incompatibility with present routine, exercise, and plan" (Moorthy et al., 2017, p. 39). These barriers are mostly linked to the usability of the service and the degree of behavioural change it requires from consumers in its use (Bagozzi & Lee, 1999; Kuisma, Laukkanen, & Hiltunen, 2007; T. Laukkanen et al., 2007). Once the innovation has been seen as incompatible with consumers' practices or customs, the consumers deliberately reject it because they perceive it as functionally inadequate and unsuited to existing workflows, practices or habits (Bagozzi & Lee, 1999; Gurtner, 2014; Sundaresan Ram & Sheth, 1989). Indeed, usage barriers seem to be the most common cause of consumer resistance to innovations (T. Laukkanen et al., 2007) because of values and risks perceived by both governments and consumers.

Value barriers are defined as resistance towards the usage of products or services (Rammile & Nel, 2012) when "they do not fulfil users' perception of performance-to-price value" (Moorthy et al., 2017, p. 40) or when the consumers have not achieved the desired experience during their use of the innovation. These barriers refer to a perceived lack of relative advantage or superior performance by the innovation over existing

alternatives (Hoeffler, 2003; Kuisma et al., 2007; T. Laukkanen et al., 2007). Consequently, an innovation must be better than “the idea that it proceeds” (David, 2014, p. 61).

Risk barriers are defined by Featherman and Pavlou (2003) as the “uncertainty regarding possible negative consequences of using a product or service” (p. 453). This type of barrier is used to explain the degree of risk associated with technological innovation (Sundaresan Ram & Sheth, 1989; Rammile & Nel, 2012). In the context of innovation, risk barriers refer to the degree of risk an innovation entails (P. Laukkanen, Sinkkonen, & Laukkanen, 2008; Sundaresan Ram & Sheth, 1989). According to Sundaresan Ram and Sheth (1989), “all innovations, to some extent, represent uncertainty and pose potential side effects that cannot be anticipated” (p. 208). Consequently, uncertainty is ingrained in innovations (P. Laukkanen et al., 2008) and, therefore, always entails at least some degree of real risk (Barati & Mohammadi, 2009).

Tradition barriers mainly refer to the change an innovation may cause in a culture or routine. The change an innovation may cause can “potentially be in conflict with existing traditions and norms of the consumers” (Gurtner, 2014, p. 8), which can, in turn, lead to resistance (Kleijnen et al., 2009). Thus, if norms and routines are “important to a consumer, resistance will be high” (Sudha Ram, 1987, p. 209). Claudy et al. (2015) regard an image barrier as the “degree to which an innovation is perceived as having an unfavourable image” (p. 530). According to Sudha Ram (1987), these barriers are associated with the origin of an innovation, such as the product class, industry, or the name of the firm. They show the consumer’s feelings about the product itself, the manufacturer, or even the area in which the innovation was produced (Kuisma et al., 2007; Sundaresan Ram & Sheth, 1989).

In the service context, an image barrier raises the need for consumers to have human contact with their service experience (T. Laukkanen & Kiviniemi, 2010; Mani & Chouk, 2018). Evidence suggests that while some consumers obviously prefer individual contact throughout the period of service, others may seek personal contact only in a specific case, such as making a complaint, getting an answer to a particular question, or solving a problem. For example, some smart applications, such as “Monitor Your Weight”, offer opportunities to consumers who suffer from obesity or who have awareness of and concern for their health to manage and reduce their weight, monitor their health status or receive information on how to improve their health.

In contrast, following the instructions of an application may generate changes in food culture or lifestyle. Individuals who see these changes as conflicting with existing routines, norms, and traditions are much more likely to resist those products (Gurtner, 2014). In response to a consumer preference for existing practices and products, an innovation needs to offer better value and performance in order to become accepted (Sudha Ram, 1987). Physical, economic, functional, and social risks influence resistance, in addition to traditions and norms, usage patterns, and perceived value and image (Kleijnen et al., 2009). This study focuses on functional barriers, as these are identified as the major obstacles to accepting innovation (T. Laukkanen, 2016; Mani & Chouk, 2017).

The IRT model has been applied and tested and is supported by past studies that focused on technological innovations in services (Table 2). Examples of these areas of innovation include mobile and internet banking (P. Laukkanen et al., 2008; T. Laukkanen, 2016), online shopping (Mani & Chouk, 2018), and the IoT (Moorthy et al., 2017; Vanston et al., 2006).

Table 2: Research that has utilised IRT

Title	Justification for using IRT	References
Consumer Resistance to Internet Banking: Postponers, Opponents and Rejectors.	To understand the innovation resistance to using internet banking.	P. Laukkanen et al. (2008)
Consumer Resistance to Innovation in Services: Challenges and Barriers in the Internet of Things Era.	To provide better understanding of the barriers that lead to consumers’ resistance to smart services as an innovation.	Mani and Chouk (2018)
Consumer Adoption versus Rejection Decisions in Seemingly Similar Service Innovations: The Case of the Internet and Mobile Banking.	To test how five theory-driven adoption barriers and three key consumer demographics influence consumer adoption versus rejection decisions in two seemingly similar service innovations.	T. Laukkanen (2016)
Barriers of Mobile Commerce Adoption Intention: Perceptions of Generation X in Malaysia.	To explore resistance factors to understand the reasons for the low adoption of mobile commerce among Generation X in Malaysia.	(Moorthy et al., 2017)

Applying Innovation Resistance Theory to Understand User Acceptance of Online Shopping: The Moderating Effect of Different Product Types.	To understand online users who know about but never (or rarely) use online shopping.	Mani and Chouk (2018)
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The literature selected above provides a clear interpretation of how technology scholars have realised and studied the importance of IRT and the reasons behind the phenomenon of resistance to innovation. For instance, in 2008, when the concern was to understand why a large proportion of bank customers were resistant to using internet banking, the researchers used IRT as an appropriate theory to study the phenomenon. In 2012, when researchers sought a better understanding of the barriers that lead to consumer resistance to smart services, considering that smart services were a form of innovation, they also used IRT. Likewise, when researchers in 2017 and 2018 intended to explore resistance factors to understand the reasons for not accepting innovations such as mobile commerce and online shopping they also employed IRT.

IRT is seen as one of the most suitable theories for consideration “by any future researchers who would conduct research relating to technological innovation” (Moorthy et al., 2017, p. 53). IRT was, therefore, considered appropriate for exploring this topic in Madinah in Saudi Arabia. The next section discusses how IRT was employed in this study to explore the barriers that affect use and adoption in order to better understand consumer resistance to SLS.

RESEARCH METHODOLOGY

This section describes the research approach taken to study SLS barriers in a Middle Eastern cosmopolitan area with a strong smart city agenda. Using a qualitative approach, data were gathered through semi-structured interviews to reveal factors that have an impact on functional barriers.

Research Approach

The research objective of this study is to build a Smart Living Services Barriers model. This approach seeks to improve our understanding of barriers through identification and classification in order to better examine why people resist the use of smart living services. To achieve an objective, research methods are the channels “through which data is being gathered and analysed within a research study” (Kellmerit, 2015, p. 44) and usually involve a quantitative, qualitative or mixed methods approach. According to Marshall and Rossman (1989), the selection of qualitative research methods depends on the purpose of the study. The value of qualitative research lies in “understanding rather than measuring the difference” (Ritchie, Lewis, Nicholls, & Ormston, 2013, p. 52). Using a qualitative method is the best approach to gaining in-depth understanding of a situation or behaviour (Pope & Mays, 1995) and was thus deemed appropriate for this research. The findings will help to understand the causes of existing barriers and it is argued that examining the barriers will lead to the analysis and creation of practical solutions for real-world issues, which will contribute to increasing the adoption of smart living services.

This research adopted a qualitative approach in order to address the research question and fulfil the research objective. Other researchers in the smart services field (Chouk & Mani, 2019; Luo, Lee, Mattila, & Liu, 2012; Sprenger, 2016; Szmigin & Foxall, 1998) have also used a qualitative approach to study issues relate to IRT. There is a general consensus that a qualitative case study methodology is the most appropriate to exploring barriers to the use of SLS, as this approach is considered to be the most effective for examining the reasons for, or explanations of, phenomena or their different impacts and consequences and how they vary between groups (Ritchie et al., 2013). Furthermore, the approach facilitates more comprehensive exploration and analysis for understanding the reasons that influence a population in their use/non-use of smart living services.

Case Study: SLS in the Al-Madinah Region Development Authority (MRDA)

To diversify the economy and develop public service sectors such as health, education, infrastructure, recreation and tourism in the Kingdom of Saudi Arabia, the Saudi government launched the *Saudi Vision 2030*. One of the main goals is to provide “a high-quality lifestyle to the citizens with modern architecture, smart mobility systems, adequate water and energy, public systems accompanied by a lush green space” (Vision, 2016). To achieve this goal, five of the biggest cities in the Kingdom were selected to be transformed into smart cities. One of the five cities is Al-Madinah Al-Munawarah, which was selected because it had hosted c.12 million visitors by 2018. That number is expected to increase to 15 million by 2020, and 30 million by 2030. In addition to the inhabitants, the millions of visitors also have expectations of a good level of services in the city, which is a significant site of pilgrimage for Moslems around the world.

Linked to the goals laid out in the Vision 2030, Madinah's local government established the MRDA. In order to provide high-quality services for both inhabitants and visitors, the MRDA conducted and supervised many non-technology projects, such as infrastructural improvements, increasing green areas, and undertaking technology projects such as the implementation of a digital transformation plan. However, this study will focus on the city's technology projects. The MRDA's technology projects aimed to provide a smart living area, in which SLS can be utilised to improve the quality of services. The MRDA was then expanded to include internet services via a fibre optic network for the entire city. Furthermore, the free Wi-Fi in the centre of the city ensures that all inhabitants and visitors can benefit from SLS. Smart parking, smart public transport cards, and translations of the Friday prayers and sermon into more than 15 languages via smart phones are examples of the SLS provided by the MRDA.

In sum, this city was chosen as the case study because it has many smart living services currently running that aim to enhance the quality of life for inhabitants and visitors and many are free and easy to use. This presents a case to be examined in order to establish what barriers exist to SLS adoption for the Middle East region. The researchers approached MRDA department heads and a randomly selected group of the Authority's customers to explore resistance to the SLS being deployed.

Data Collection and Analysis

Sixteen semi-structured interviews were conducted at MRDA offices using open-ended questions. The interviews were between 45 and 86 minutes in length and took place with six MRDA head managers (M) and 10 MRDA customers (C). The managers were chosen as they were responsible for SLS and had performed a variety of tasks within the MRDA (Table 3) related to deployments of active SLS. The customers were chosen randomly, based on all having received marketing campaign information from MRDA about the features of their properties.

Table 3 Interview breakdown

No.	Interviewees	Length of interviews
1	Head of Technology and Systems Department	59 min.
1	Head of IT Management	73 min.
1	Head of Digital Cities Programme	86 min.
1	Head of Survey and Geographic Information Systems (Hielkema & Hongisto) Department	66 min.
1	Head of Projects Department	52 min.
1	Head of the Office of Realisation of Vision 2030	62 min.
10	Customers of MRDA	517 min.
16	Total	15 h and 25 min.

All the interviews were digitally recorded with prior permission from the participants. All the interviews were later transcribed *verbatim* for analysis. The data collected were analysed using three coding techniques: open, axial, and selective coding (Birks, Fernandez, Levina, & Nasirin, 2013; Jones & Alony, 2011), supported by the NVivo software program. Initial codes (331) were then reviewed, analysing the relationships between them, and summarised into a total of 99 concepts (axial coding). The concepts were then categorised into 34 categories (selective coding).

The open coding technique was employed first to analyse the data (Biswas & Sarkar, 2000). The transcript of each interview was examined to capture important concepts related to barriers to the use of smart living services. Barriers could include any physical or non-physical obstacle or reasons that prevented or made it difficult for people to adopt smart living services. The data were coded based on concepts identified in the literature and the results are presented in Table 4.

Table 4: Process of analysing data

Category	Concept	Code/Open Code	Excerpt
Lack of infrastructure	The need to have an appropriate infrastructure	No underground infrastructure	Interviewee 2 M: " <i>there is a lack of underground infrastructure.</i> "
		Not a fit with infrastructure	Interviewee 11 C: " <i>I used to have a smart electric meter in my house. It was an excellent device and it had saved me time, money and effort. When I wanted to buy the newer version, which was easier to install, I couldn't activate</i>

			<i>it because it did not fit with the same building.”</i>
	Consumers have to understand what SLS are	Customers need help to understand	Interviewee 13 M: <i>“I think there has to be awareness and education in this marketplace to help the customer understand, you know, the value there, as a customer understands the benefit of using.”</i>
		Low level of understanding	Interviewee 3 M: <i>“when that development was done, there was very low level of customer understanding.”</i>
Lack of usability	Level of difficulty in using SLS	Smart technology means it is more difficult	Interviewee 10 C: <i>“I think technology is difficult already, when you go smart, it’s even more difficult.”</i>
		Difficult to use	Interviewee 14 M: <i>“I stopped using this service when I found that it was difficult to use in some regions of Saudi Arabia; there were some delays.”</i>
	The need to access SLS easily	Accessibility	Interviewee 13 M: <i>“there are many places in the world that offer free Wi-Fi, but they first require the user to enter either his phone number or his email.”</i>
		Limited access	Interviewee 1 M: <i>“Some smart services are not available to the public, but it is available for some sectors that need it.”</i>

If a statement made in an interview referred directly to a barrier described in the literature, such as *“there is a lack of underground infrastructure”*, the code given was “No infrastructure”. Next, this code was merged with similar codes, such as “Need for smart infrastructure” to create one concept: “The need to have appropriate infrastructure”. Likewise, this concept was merged with a similar concept, such as “Consumers have to understand what SLS are”, to create one category: “Lack of infrastructure”. The next step was to merge this with a further similar category, such as “Lack of usability”. This process was applied to all the interviews to analyse the data. The final step was to combine the two newly formed categories under the “Usage barriers” classification (Figure 3).

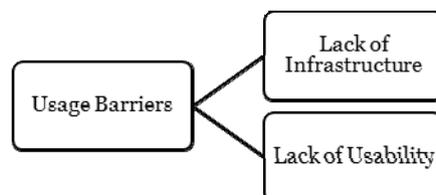


Figure 3: Process of data analysis

If a statement referred to a number of benefits, such as *“when we transferred to smart services, we saved a lot of money, it provided a perfect service in a short time, made the right decisions, and reduced the effort with the high quality of the services”*, the code assigned was “Need to convert to SLS”. The same process as the one referred to above was also applied at this stage.

Finally, if a statement referred indirectly to a barrier, such as *“I think there’s a very different level of customer understanding”*, indicating a lack of understanding of SLS among customers, which is clearly seen as a barrier, the excerpt was coded as “Different level of understanding”. The same process of analysis was applied here too.

The next section presents a discussion of the findings of the preliminary analysis of the data that centred around functional barriers and extends our view of SLS adoption.

FINDINGS

This section presents the findings from the 16 interviews conducted for the study. The analysis identified three new additional barriers that have not previously been identified in the literature: lack of user feedback, lack of migration incentives in the use of SLS, and lack of language options.

Support for Functional Barriers to SLS Adoption Identified in the Literature

Generally, the data were consistent with the barriers identified in the literature. Rapid development, lack of knowledge, lack of awareness, and poor understanding of user needs are examples of barriers that have been identified in previous literature and were also found in the interview data. Some of the interviewee statements that clearly support previous findings are presented in Table 5.

Table 5 Barriers identified in the literature and the current research data

Literature reference	Code	Data
Nikayin and De Reuver (2015); Shieh, Yeh, and Lai (2013)	Rapid development	Interviewee 16 M: <i>“Well, technology is developing very rapidly, and every day there’s something new. So, sometimes, if I don’t use the device in a certain period, I will be too late. You can imagine how many technologies you have witnessed in the past 30 to 40 years. The development pace is very rapid, and if you don’t keep up with it, you will be left behind.”</i> Interviewee 13 M: <i>“It’s a bit difficult for us to catch up with the leading countries when it comes to technology. We couldn’t catch up with the rapid technological development.”</i>
W. Keijzer-Broers and de Reuver (2016)	Lack of knowledge	Interviewee 5 M: <i>“The first one is the lack of knowledge about technology itself. The second cause is that some technologies are hard to understand and implement in the beginning for some people. So, you should make everything clear for the user. There are many things that people ignore. There are people who don’t believe that some devices can really do the technological tasks described.”</i> Interviewee 11 C: <i>“I see the main barrier is the lack of knowledge. Also, some smart living services have a level of difficulty in 1) registration and 2) in use as well.”</i>
W. Keijzer-Broers et al. (2016); Saied Al Surf, Trigunarsyah, and Susilawati (2013)	Lack of awareness	Interviewee 1 M: <i>“That’s why I talked about awareness. You should educate people before introducing the service. Do you know why the Malaysian and Indonesian experience was successful? Because they made people aware before they introduced their smart services. They show people renderings of the smart cities with all the details so they can get familiar with them.”</i> Interviewee 2 M: <i>“There was very, very little awareness at that time here in the regional market of smart services and smart capabilities.”</i> Interviewee 6 C: <i>“So, I started discovering the useful features that I didn’t know before. I think one of the barriers is that sometimes the technology is too advanced for a region. The first thing is cultural awareness.”</i>
Wilson et al. (2015)	Poor understanding of user needs	Interviewee 7 C: <i>“They take notice of the problem, but the solution isn’t always implemented in the way that the user likes.”</i> Interviewee 10 C: <i>“That there was a mismatch between the smart services brought in the country with the needs of the residents... You can’t take a service from another country and implement it here. We have our own needs and problems. And that’s what makes a service successful or not, it’s whether or not it’s customised.”</i>

With the rapid development of SLS, the participants commented that smart services were being developed very rapidly, thus making most of the services obsolete in a short period of time. It was also difficult for developing countries to catch up with developed ones due to the rapid technological development of the latter. With the lack of knowledge of SLS, interviewees stated that one of the main barriers to innovation was a lack of knowledge - people did not have the know-how to use smart services. It was, they felt, difficult to use some of the SLS. Together with the lack of awareness, interviewees reported that there was not enough cultural understanding and realisation of the importance of scientific research in technology. The developers of the systems did not create awareness of the existence and usage of smart services. Finally, in terms of the poor understanding of user needs, participants noted that there was a disconnect between what was available in the market and what users needed.

New SLS Barriers Identified from the Current Case Study

In addition to the interviewees confirming much of the existing research regarding barriers, three new barriers emerged from the data collected for this case study. The newly identified barriers have implications for innovation resistance theory, SLS adoption by Middle East consumers, and smart living policy. The new barriers are described below and detailed in Table 6.

Table 6 New barriers identified from the data

Barrier	Definition	Data
Lack of user feedback	Lack of information opportunities for customers to express their user experience (good or bad), opinions, advice, or comments about the smart living services they are using.	<p>Interviewee 13 M: <i>“I should ask them for their feedback and the problems that they have experienced. These people can be aware of problems that I don’t know about from my position.”</i></p> <p>Interviewee 13 M: <i>“So, today, the feedback from the people working on the site rarely reaches the decision makers.”</i></p> <p>Interviewee 1 M: <i>“The problem is most of the smart living services have no feedback icon that gives consumers the chance to share their experience or their issues they have faced. So, if the supplier provides feedback in an easy way, I think this will maybe help to overcome some issues.”</i></p> <p>Interviewee 13 M: <i>“No smart living services have asked me to leave feedback.”</i></p> <p>Interviewee 13 M: <i>“The absence of feedback is a barrier; it does give you an idea about the gaps in your service.”</i></p> <p>Interviewee 13 M: <i>“The companies should ask for user feedback.”</i></p> <p>Interviewee 13 M: <i>“There are things that only the visitor who is close to the service knows; maybe I don’t know about those things since no feedback has been given.”</i></p>
Lack of migration incentives in the use of SLS	Lack of motivation for individuals to migrate to smart living services.	<p>Interviewee 14 M: <i>“In technological applications, there should be incentives that attract people to use the service.”</i></p> <p>Interviewee 10 C: <i>“In my opinion, if the technology is first adopted by the government and its institutions, that will motivate people to adopt it faster than if there were only individual people putting their effort to use the service.”</i></p> <p>Interviewee 14 M: <i>“Especially here in Saudi Arabia, nobody gives you motivation to use the technology. We lack the encouragement to utilise the advanced technology and we also need to start using it in order to keep up with developed countries.”</i></p>
Lack of language options	User cannot find an appropriate language to enable him/her to use smart living services.	<p>Interviewee 13 M: <i>“I can say language is a barrier. Sometimes, the technology is available either in English or two languages only: the local language and one foreign language.”</i></p> <p>Interviewee 9 M: <i>“The differences in language are a huge barrier. We provide a very advanced service to the visitors, but the problem is the visitors to the Prophet’s Mosque are from all nationalities and speak all kinds of languages, so the differences in language are a problem, we can’t provide that services with all languages.”</i></p> <p>Interviewee 14 M: <i>“But it is indeed...a barrier when someone comes from another country and he knows neither Arabic nor English. We need to provide him with support to use our smart services.”</i></p> <p>Interviewee 16 C: <i>“I bought from Amazon, a smart device [virtual reality glasses] from China but I couldn’t use it because it was in Chinese.”</i></p>

The first new barrier discovered was the lack of user feedback and can be defined as a lack of information opportunities for customers to express their user experience (good or bad), opinions, advice, or comments about the smart living services they were using. This barrier represents two different perspectives: a managerial perspective and a user perspective. From a managerial perspective, some of the SLS managers regard feedback from users as a pillar to use to keep improving and to fix issues that may appear for consumers from time to time. The result will then be improved, advanced SLS free of error.

The data show the interaction between the SLS and the user, which is positively reflected when users see that their feedback has been considered by the decision makers. Therefore, users may feel that they have become partners in the success of a service, as their feedback has been used to work towards the development of the product. This may increase users' loyalty in adopting more services in the future. Other feedback from SLS users shows potential and dynamic interest among consumers. Therefore, providing feedback to decision makers will increase the efficiency of SLS, which will lead to increased adoption of those services. In contrast, from the user perspective, some customers regard the absence of a feedback icon as a disadvantage, which may cause them to leave the service and they may not use it again. Thus, the presence of a feedback icon in smart living services could contribute significantly to reduced resistance.

The second barrier evident from the data is the lack of migration incentives in the use of SLS. This barrier can be defined as a lack of motivation in individuals to migrate to using smart living services. One of the interviewees, 14 M, stated that "*there should be incentives that attract people to use the service*". Therefore, as ease of use is not the only reason to use SLS, individuals might start to move towards using SLS instead of a traditional facility if there were an incentive to use the new services. Moreover, one of interviewees, 10 P, remarked that the adoption of SLS by the government could be considered a major motivation to people to want to adopt SLS. However, the lack of migration incentives will cause resistance to SLS, especially in people who see no reason to leave the traditional services with which they are familiar.

The third new barrier observed in the data was the lack of language options. This barrier appears when users cannot find an appropriate language to enable them to use smart living services. This causes a barrier to people starting to use SLS. Limited language options within SLS, with only two languages used currently, presents a barrier for people who speak other languages. One interviewee made this point by stating that "*we provide a very advanced service to visitors, but the problem is the visitors to the Prophet's Mosque are of all nationalities and speak all kinds of languages, so the differences in language are a problem. We can't provide the services with all languages*". Thus, multilingualism in SLS is essential for both the people using the services and for the SLS providers to ensure that what is being offered is fully useable.

In summary, the three new barriers identified above contribute directly to resistance to the adoption of SLS. The squares shaded grey in Figure 4 illustrate the three newly identified barriers that represent the contribution of this paper to IRT: lack of user feedback, lack of migration incentives in the use of SLS, and lack of language options. The evidence suggests their significance as barriers to adoption, providing insight into why individuals resist the new SLS options. It is recommended that these barriers should be addressed in order to increase the adoption of SLS.

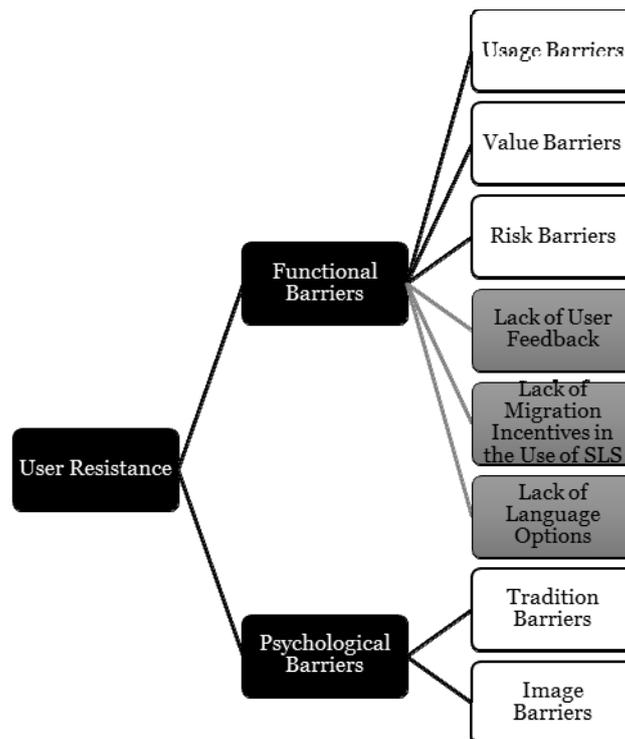


Figure 4: Barriers to adopting smart living services

This study was conducted in a region that has shown an interest in increasing the number of smart cities. It is important as a case study to help understand the reasons for people resisting using and adopting new technologies that are made to improve the quality of their lives. The data suggest that the three new barriers identified in the study are significant because they represent factors that have an impact on the government's ability to operate SLS platforms successfully. This means that governments that are trying to build more smart cities need to consider how these barriers will limit the functions of the technology in their cities. A potential limitation of this study is that the case study was conducted in a region that is well resourced, where the government has been working on the smart city model for a number of years with well-established investment in new infrastructure. Another potential limitation is that the study was conducted in one place; future research should be conducted in multiple places in the region to examine if the evidence presented here is consistent.

DISCUSSION

This section provides conclusions regarding the study findings and outlines their implications for technology adoption and resistance to it. It describes why the findings are important to successful outcomes for the smart city agenda. By changing how governments present SLS technology to their citizens, who are also their consumer base, policies and practices can be changed to benefit everyone. The section concludes with implications for theory, practice, and policy.

Study Impact and Future Research

This study explored a region of the Middle East at the centre of the Smart City Global Initiative. Policies, infrastructure investments, and other financial support have helped to realise the potential in the region's ability to shape future cities. The region's cities are experiencing a boom in unprecedented ways due to a number of challenges caused by war and migration. This means that the systems that are supposed to help people experience a better quality of life have to be easy enough for them to use in order to obtain that improvement in standards. The literature review presented barriers in light of a progressive smart cities agenda and policies that are rapidly developing the technology to demonstrate that, by using data, people can achieve a better quality of life. In order to achieve improvement, there is a need for services in the areas of health, energy, transportation, and even entertainment to support a higher living standard. Smart living services are critical to the success of the smart city agenda and its adoption, offering key insights into how data are collected to power new IoT platforms. The research supports claims that SLS adoption is an indicator of the success of the policy.

This study used innovation resistance theory to investigate the barriers that the existing literature shows can cause resistance to innovation. Although experts agree that there are functional and psychological barriers associated with use, values, risk, traditional, and image, this study suggests there may be more. Prior to this

study, there had been no research carried out to explore and examine barriers to the adoption of smart living services. Thus, examining barriers to the adoption of SLS is a critical issue that challenges the existing research on innovation adoption and resistance. What this study shows is that people resist technology because it is not 'speaking their language' and because there is no way to give feedback. It is possible that the sentiment to use this technology is not there due to the lack of an incentive to encourage its use.

A future direction of research could be to delve deeper into technology adoption to establish if it relates to a short- or long-term change. Research could look more closely at the government departments that help to support SLS platforms, track how many people use the platforms and how long they stay using them. When numbers dip, that would be the time to offer marketing promotions to stimulate interest and remind people that the services are helpful. This could, for example, be a reminder that a tracker could let travellers know when the next train or taxi is due to arrive or it could be that a monitor can tell doctors about changes in blood pressure or blood sugar. There are many ways that IRT could be used as part of an SLS adoption strategy to help the smart city agenda that have yet to be explored.

Implications for Adoption Research, Adoption Practice, and Smart City Policy

The research found a number of implications for research, as IRT theory can be applied and extended to other areas of technology use. Additional implications for practice to better develop the right SLS technology point to policy implications as governments are making aggressive attempts to implement new policies and initiatives quickly.

The IRT model has been expanded in this study to include three additional barriers: lack of user feedback, lack of migration incentives in the use of SLS, and lack of language options. This expanded theory gives future researchers more dimensions to consider in order to explore the reasons for people's resistance to innovation. Departments in governments that are responsible for monitoring SLS platforms should also be able to find ways to determine actual usage. They should provide ways for people to give feedback and voice their concerns if the platforms are not doing what they are supposed to do. These departments have the ability to change features, so that by listening to people, they can employ better ways to support them. There is a lot of funding around smart cities, and this money should be used wisely.

This study examined people's views of the smart living services that are available to them and identified reasons for resistance to them. By examining the reasons for a lack of interest in or awareness of smart living services, the study will contribute to helping Gulf states build better cities and amenities. Another important reason for smart living services adoption is the impact that it could have on the diversification of an economy. For many in the Gulf state region, there is a need to move beyond being an oil-based economy. Technology provides an opportunity to do this, so better understanding of why people resist this innovation offers a means to improve SLS.

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An introduction to smart city research: A review of the past and the future

(Full Paper)

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ABSTRACT

Smart city is a growing area of research. Its scope is broad as it touches individuals' life, government, and environment. Advancement in digital technologies, particularly the Internet of Things, have enabled cities to become smarter and thus affected many structures (physical, social, etc.). Given such broad scope and the effects the smart city could bring about, the growing numbers of research seems to be inadequate. This paper attempts to review the past studies and identify what have been done and not done. Smart city research related to Southeast Asia in particular is also looked at in this paper. The literature was categorised and discussed under three main aspects concerning the area of management information systems, namely business, organization and technology. Gaps are identified, and future research are called for.

Keywords: Smart city, Literature review, Social organisation, Business, Technology, Southeast Asia.

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INTRODUCTION

The aim of this paper is to provide a quick jumpstart into the field of smart city research. Research on smart city has received much wider attention especially in the past ten years. The advancement in smart city developments worldwide owes to the rapid growth in mobile and sensor development and adoption. The goal of smart city is to enhance quality of life, living conditions as well as sustainability of natural environment through the more active and effective engagement with citizens (Dameri & Rosenthal-Sabroux, 2014). Not only the technologies that are advancing, cities are also changing. Urbanization are happening around the world, and this has created many new social requirements and changes. Therefore, smart city is not only about adoption of new technologies or innovations. The path towards smart city and being a smart city affects various aspects of individuals and social organisations that they are a member. This study attempts to explore this huge area of research and identify current contribution as well as gaps in the area. Existing literature on the area is therefore reviewed.

In addition, the paper looks specifically at smart city literature that have been conducted in or related to Southeast Asia. According to the United Nations Population Division, 65 percent of the population in Southeast Asia will live in urban areas by 2050. The huge percentage draws attentions and needs to efficiently and sustainably manage cities in the region. Therefore, it is worth looking at progress and what have been done in this region. The paper aims to shed some lights on how cities in this 'urbanizing' region can be benefitted from smartising cities.

The following section outline how the researcher selected literature to be studied. The selected literature was explored by analysing research keywords and categorising the previous research into areas, namely business, (social) organization, and technology. Smart city literature focusing on Southeast Asia are then discussed. Gaps are then identified and discussed in the conclusion.

RESEARCH METHOD

The key objectives of this study are to learn from what have been studied in an rea of smart city and identify gaps in the area. The literature review and synthesis is therefore deemed most appropriate.

The researcher did a search in Scopus database smart city and, using smart city and digital technology as search keywords. Other search criteria are publication years, types of publications, and areas. In terms of publication years, studies published from 2010 to 2020 were included. Only journal articles and conference papers were selected, and the included areas of study were social science and business & management. Specified all of the abovementioned criteria, 305 papers were returned.

117 Papers were screened out. The excluded papers were usually about technical aspects of particular technologies without discussing the usages, applications, or relations of the technologies to any context. An example paper was that of Shi J., Ming Y., Fan C., & Tian L. (2017) which discuss the technical aspect of facial recognition technology. Although facial recognition can be applied in many scenarios concerning smart cities, the paper only discussed an appropriate algorithm for the technology

without relating to any specific issues that might impact the algorithm if the technology is used in the context of smart cities. Therefore, the author excluded this paper from the primary search result. In total, 188 research papers were further analysed.

Of particular to the goal of this paper to look specifically at Southeast Asia region, the researcher again conducted a search in Scopus database. Combinations of smart city and the name of each country in Southeast Asia as well as the word 'Southeast Asia' itself were used. Other criteria, including types of publication and publication years remained the same. Search results were as follows:

- Smart city and Southeast Asia returned only 3 papers, and all are related to Singapore
- Smart city and Thailand returned 25 papers. However, if computer science papers, which focused only on advancement of Information Technologies, were excluded, the results would include only 13 papers.
- Smart city and Philippines returned 16 papers, but all are science or applied science papers
- Smart city and Laos returned no result
- Smart city and Myanmar returned 5 papers which were all about science and technology.
- Smart city and Cambodia returned no relevant result
- Smart city and Timor-leste returned no result
- Smart city and Malaysia returned 63 papers
- Smart city and Indonesia returned 9 papers
- Smart city and Vietnam returned 12 papers
- Smart city and Brunei returned only 1 paper
- Smart city and Singapore returned 35 papers, excluding material science, mathematics, and other applied science papers

DATA ANALYSIS AND DISCUSSION

This section presents and discusses the result of literature synthesis. It includes the discussion on definition and scope of smart city, the findings from an analysis of keywords extracted from the previous studies, and the business-organisation-technology perspectives (A framework adopted from Laudon & Laudon (2017)'s MIS textbook)

Definition and scope of smart city

Smart city can be broadly understood as a form of urban innovation, concerning economy, people, lifestyle, governance, mobility, and environment (Nam, *et al.*, 2011). Therefore, smart city development involves investments not only in technologies but also human and social capital as well as organisational and policy innovation (Ojo *et al.*, 2014). In terms of the ultimate goals, smart city efforts should lead to sustainable economic growth and a high quality of life, while at the same time focus on managing well the natural resources through participatory governance. In essence, smart city is a complex "Socio-technical System of Systems" (Ojo *et al.*, 2014), for example economic systems, social systems, environment systems, etc.

From the definition of the smart city, it can be seen that the scope of smart city research involves various aspects. City-infrastructure wise, the scope covers transportation & mobility, energy, water, library, school, and many more. Technology wise, advancement, adoptions, and applications of IoTs, Big Data, Sensors, and AI are among the top lists. Related to technological areas are data issues, concerning data models, data management, data privacy and security, geospatial data, etc. Additionally, the relationship between government and citizen, the way to engage citizen, citizen's roles, individual's lifestyle, the form of communities, politics, and governance are all affected by the urbanization and smartization of the city. Smart city also involves issues concerning digital transformation (Brandt *et al.*, 2016). It is essentially the transformation that affects several components/members of a city.

This list of concerning issues is not definite. In fact, it is only the tip of a smart city iceberg. The next section further reveals what have been covered and uncovered.

Keyword analysis

The 188 papers involve 633 distinct keywords. Unsurprisingly, 'smart cities' or 'smart city' are the most popular with the frequency of 73 and 46 occurrences respectively. However, the word 'smart' have been used in 55 distinct keywords (listed in Table 1), for example, smart government, smart home, smart community, smart neighborhood and smart parking. This is in line with the wide scope of smart city discussed in the previous section. The tag cloud created from the 633 keywords (as shown in Figure 1) also shows that the word smart has been referred to most often, and other often-seen words are digital, data, technology, urban and city. In addition, the figure reveals that technology, ICT, innovation and data are usually involved when researchers think of smart city. In other words, information technologies are considered an important part of smart city. The further analysis into the top 5 keywords apart from smart city (and smart cities) shown in table 2 confirms that the main interest of smart city is concerned with technologies. Social and business aspects are missing from this set of keywords.

Table 2: Top 5 keywords (when excluded smart city)

Keyword	Frequency
Big Data	22
ICT/ICTs	19
internet of things	18
digital technologies	11
digital city	6

Keywords containing data or information appeared altogether 79 times, as often as keywords concerning technologies. Various aspects of data and information are studied. Examples are data structures, data economy, data models, quality of data, security, and privacy concerns. The relatively high number of data-related keywords show that an ability of smart city to generate a lot more data is well recognised. However, to be able to fully benefit from the big data (that will be generated from a smart city), research concerning how to structure, store, secure, and manage the data are still needed. Additionally, since technology's providers and city managers (or governors) will have access to data that reveal almost all aspects of citizens' life, data privacy, security, and ethical use of data should be put to priority. From Table 3, nonetheless, keywords related to these areas appear in extremely low number, showing a big gap and a need for further study.

Table 3: Keywords containing data or information

Keywords containing data or information			
Keyword	Frequency	Keyword	Frequency
Big Data	22	Geoinformatics and smart city	1
open data	4	Geospatial information	1
data analytics	2	Informatics	1
data economy	2	information quality attributes	1
Information	2	information security awareness	1
Information insecurity	2	information sharing	1
information islands	2	information society	1
urban informatics	2	information technology	1
3D geospatial data	1	informational footprints	1
3D spatial database	1	information-technological platform	1
Big data visualization	1	infostructures	1
community informatics	1	metadata models	1
data	1	mobile phone data	1
data collection and update	1	public geospatial information	1
data commons	1	public sector information	1
data marketplace	1	research data	1
data mining	1	research data management	1
data ownership	1	secure data contribution	1
data privacy	1	spatial big data	1
data self-determination	1	spatial data infrastructure	1
data structure	1	spatial data mining	1
data-driven decision-making	1	temporal data	1
data-driven smart city	1	temporal-spatial information infrastructure	1
Decentralized data storage	1	transit data	1
digital data	1		
Total 49 distinct keywords, 79 occurrences			

Keywords containing ‘urban’ are also popular with the total frequency of 58. Examples of keywords, containing ‘urban’ are smart urban, urbanism, urban planning, urban design, urbanization, etc. Less often-seen keywords are those concerning governance and/or government (with 24 occurrences), citizen (with 18 occurrences), security and/or privacy (with 15 occurrences), and policy (with 7 occurrences).

Interestingly, while lifestyle is included in the definition, only one keyword related to lifestyle, which is “unhealthy lifestyle”, appeared only once from 960 occurrences of 633 distinct keywords. This highlights a big gap in the existing literature where focus was mainly put on technological issues. An attempt to categorise existing literature into business-, organisation-, and technology-related studies in the next section further identifies this gap.

Organisational, Business, and Technological aspects concerning smart city

This section discusses what have been done in prior literature on smart city and highlights gaps or issues that have not been addressed. The discussion is categorised into 3 aspects, namely business, (social) organisation and technology. The three aspects are an overarching framework that has been used in Laudon and Laudon’s MIS textbook for many years. According to Laudon and Laudon (2017), to successfully apply and manage information systems in any organization, issues related to business, organisation, and technology need to be taken into consideration. Considering smart city an application of several new information systems in a large-scale and complex organisation, the researcher perceives the framework as an appropriate lens which provides a top-eye view of interrelated components of complex problems. The following subsections, therefore, categorise and discuss the existing literature from the aspects of technological, business and (social) organisation, respectively

Technological aspects

The technical aspects of smart city have been widely studied and well covered. Digital technologies that have been studied includes various technologies for various usage scenarios. Examples are:

- Design of a cloud-based backup center (hardware & software platform for data sharing, exchange and backup) for digital highway (Zhou *et al.*, 2019)
-
- Blockchain technology and its application to storing and managing citizen’s identify in the context of smart city (Rivera *et al.*, 2017)
- Big Data analysis techniques and applications to better understand and manage cities (Balduini *et al.*, 2019)
- Big Data engine for integrating and analysing a large volume of heterogeneous data generated by various sources in the smart city context (Attanasio *et al.*, 2016)
- Experiment to test the performance of Hybrid Adaptive Bandwidth and Power Algorithm to optimize power drain, battery lifetime, delay and packet loss ratio (Sodhro *et al.*, 2019)
- Designed data standards of Internet of Things, covering issues such as real-time acquisition, mass storage and distributed data service of mass sensors (Wang *et al.*, 2014)
- Developed an ontology for the description of smart cities data (Dias *et al.*, 2018)
- Presented a technique of three-dimensional data analytics using dendrogram clustering approach to analyse Big Data generated from smart cities (Azri *et al.*, 2018)
-

While there are many issues to cover ranging from design to implementation and performance evaluation, research in this area is quite well advanced. Algorithms, data structure, data exchange, security, infrastructure of hardware and software platforms have been tested and tried. The more important issue is how businesses and (social) organisations can apply these advanced technologies to enhance the ‘smartness’ of the city, including quality of life and sustainability of environment.

Business aspects

Business models are among the top issues discussed in the previous literature. While Pucihar *et al.* (2019) focused on business models of a particular ‘smart’ product, which is autonomous vehicles, Brock *et al.* (2019) looked at different business models that could fit technology-driven companies working on different types of projects within different ecosystems. Markendahl *et al.* (2018) called for a networked business model (instead of a single firm business model) as a smart city solution usually requires a number of entities to be connected and work together, thus involving a number of stakeholders at the same time. Similarly, Bullinger *et al.* (2017) pointed out that to co-create value in smart service ecosystems, existing business models need to be adapted. In short, business models were developed at different levels, for example, at the level of product/service, at the level of technology providers’ business, and at the level of city. However, from the scope of smart city outlined in the previous section, sustainability is considered an important goal of smart city management, rather than revenue and profit like in other business cases, yet none of the selected literature examined closely on a business model that would enable a smart city to achieve this goal.

Ecosystem is another topic that has been widely studied, yet from variously different perspectives. Theoretically, the business ecosystem perspective enables researchers to focus on a more interconnected view, rather than a pipeline view, of cross-industry/cross-organisation collaboration. According to Anggraeni *et al.* (2007), economic activities (as well as business and social activities) have changed from stand-alone to interconnected agents. Therefore, an understanding of continuous interaction and behavior of interconnected organizations becomes essential. Strategic management, or the management of a smart city in this context, will involve more multiple theoretical paradigms that explain complex relationships. Studying any social organization from the ecosystem perspective, thus, can be useful in building an overall picture of how the complex relationships are emerged, transformed and organised.

From the selected literature, quite a few studies looked at smart city from the ecosystem perspective. For example, Gupta *et al.* (2019) focused on the design of ecosystem and the distribution of knowledge across the smart city ecosystem. Sarma & Sunny (2017) were interested in the roles of each ecosystem actor in developing and participating in smart city. Alizadeh & Sipe (2015) highlight the need of city for digital strategy as the ecosystem has changed (in becoming smart city) as well as the roles of stakeholders.

In terms of managing smart city, Mgbere *et al.* (2018) designed information model needed for managing smart city construction projects. Waedt *et al.* 2016 discusses the increasing numbers of assets needed in smart city development and highlights city's needs for a better asset management approach that covers automatic asset identification and tracking, safe application of each asset and risk assessments.

How to apply data to manage the city were also studied in several previous studies. Ortner *et al.* (2016) studied the design of interaction process and application supporting decision-making in smart city context. O'Neill & Peoples (2016) looked at data collected from sensors around the city and how they can be used for monitoring well-being and city experiences and thus improving investment in and maintenance of infrastructure and services

To sum up, while the city management approach will change tremendously, only few studies have started to explore this topic. Changing business models as well as ecosystems is another area that has received attention from the IS researchers. However, new business opportunities and challenges opened up from these changes have barely been addressed.

Social organisation aspects

A type of organization that is of concern to this paper is social organisation as one of the important aspects of city is society and social changes around it. Considering the definition of smart city, we can see that social is a huge area involving various issues, such as quality of life, citizenship, citizen's participation, individual's lifestyle, culture, and so on.

Many studies had already attempted to cover a few of these issues. Tian *et al.* (2018), for example, examined the changing role of citizens (in smart city context) and proposed a new concept of smart citizen with four dimensions: slacktivism (and knowledge bubble), personal digitalization, virtual social relationship, and digital life process burden. The researchers suggest that future research focus on how an individual under smart city environment should respond to the four challenging perspectives. Santos *et al.* (2017) observed the real-life city transformation process and proposed strategies, methodologies and best practices for sensitization, civic engagement, social empowerment and sustainable motivation to participate in the co design and co creation of a human smart city. Han & Hawken (2018) highlighted identity (of city), urban culture, and quality of life as one of the main areas that needed to be focused when designing and digitizing a city. Vallicelli (2018) showed that workplace culture is changing by analyzing relevant data from Twitter. The authors believed that transit hubs, urban amenities and new digital services will influence on how workplace culture will be reframed.

While smart city involves all aspects of individual's life, only few of them have been studied. In fact, every touch point that individuals interact with the city (physical buildings and infrastructures) or people (government admins, police, teachers, sale persons, etc) are changing. Therefore, the relationships need to be redesigned. In addition, the new interactions (and relationships) will eventually constructs and reconstructs a city (as a social organization). In summary, smart city will tremendously change the social structures, and the existing literature has touched only the small part of these changes.

Smart city in Southeast Asia

Publications in Scopus that concerns smart city initiatives or projects in Southeast Asia are limited. As mentioned in the research method section, no publications were found for several countries, including Cambodia, Laos and Timor-leste. Only one paper was founded related to smart city in Brunei. The paper compared two methods of controlling traffic congestion and demonstrated how adaptive traffic light system can be used to minimize traffic congestion during peak hours in Brunei. The study focused more on the technological aspect, investigating which algorithm is better in this particular case.

Singapore, Malaysia, Thailand, Philippines, Indonesia and Vietnam appeared to be better studied. More studies were found, and more issues have been researched. Of all the mentioned countries, Singapore is considered the most advanced and well recognised in terms of smart city. According to Nicholls and Kruiemel (2019), Singapore's 'Smart Nation' programme has just

started in 2014 but was quickly recognised as a world leader in smart city initiatives. One of the successful initiatives was the 3D digital map of the country which can be used to support urban planning, flood control, and so on. Kong and Woods (2018) critically examined the Singapore's Smart Nation initiative and identified three important issues that must be considered when implementing any smart solutions. The three issues include data-driven feedback loops, effective public-private partnerships, and an integration of past, present and future urbanisms. Lopes (2017) studied and compared six smart cities, including Singapore and found that all smart city initiatives underlie heavily in technologies and followed similar governance model which was a mix of collaborative, open and participatory governance. In essence, technologies and smart governance are key components to smart and sustainable cities. Interestingly, Ho (2017) used Singapore as a case study to highlight the limits of 'smart' initiatives and challenged practitioners, city managers, and governors to put citizens' needs and lifestyles at the center when designing or planning 'smart' solutions.

Specific to Thailand, smart city is usually discussed under the umbrella of Thailand 4.0, the national policy to drive the country with innovation. The Thailand 4.0 initiatives concerning smart city are, for example, industrial Internet of Things and smart farming. Taweesaengsakulthai *et al.* (2019) provided a detailed comparative study of how smart city initiatives were rolled out differently in 3 big cities, namely Phuket, Chiangmai, and Khon Kaen. Phuket was considered the first testbed in terms of smart city in Thailand, followed by Chiangmai and Khon Kaen. Khon Kaen's smart city was mainly driven by local business leaders who together co-established a nonprofit private company and engaged local people to the implementation of the smart city, successfully showcasing the bottom-up approach. From the comparison of the three smart city initiatives, the authors highlighted that a lack of clear and coherent policy statements and the central bureaucratic management made the smart city initiatives slowly developed and not serving the local's needs. Similar to Taweesaengsakulthai *et al.* (2019), Laochankham *et al.* (2019) reviewed and critiqued the national policy concerning smart city development. The authors stated that direction without a clear policy statement and highly centralized bureaucratic management style impede the country from reaching the full benefits of smart city policy implementation. A few other papers (e.g. Kordach *et al.*, 2018; Setthapun *et al.*, 2015) looked at smart city initiatives from the perspective of technology implementation and did not consider the social or business aspects of the smart city.

Focused on Ho Chi Minh city, Nguyen and Nguyen (2018) studied the design of high-rise houses within the framework of the smart city concept and presented an approach that was claimed appropriate for future constructions towards smart city development. Ha and Fujiwara (2015) developed a value-based event tree to value R&D projects especially those concern the movement towards smart city to help drive investment decisions and carefully take into consideration the issues of technological and market uncertainties. Similar to research in other countries, apart from these two papers, the other papers that were yielded from Scopus was more about technical aspects, such as numerical modeling for groundwater management (Glass *et al.*, 2018), and power system modeling for distance protection relay (Huyhn and Tran, 2017).

Pratama (2018) compared smart city policy of four Indonesia cities, including Yogyakarta, Surabaya, Magelang, and Madium; all of which were winners of the Indonesian Smart City Index 2015. The author pointed out a lack of specific national-level regulation that guides smart city policy in Indonesia and thus resulting in different conceptualisation of smart city by the four cities. Another attempt to study topics related to smart city in Indonesia was that of Indrawati and Dayarani (2019). The authors looked at indicators using for measuring the index level of smart security and safety in Bandung city of Indonesia. Twenty indicators to measure the index level of smart security and safety were presented. Again, no other attempts were found to understand socialization process as well as social impacts of the smart city implementation on citizens' life.

Particular to the Philippines context, research topics related to smart city are relatively more variety compared to other Southeast Asia Countries mentioned earlier. A smart disaster management system (Alazawi *et al.*, 2014), challenges and opportunities for smart city establishment and the required ICT infrastructures (Al-Maliki, 2018), user acceptance of the smart toilet (Zakaria *et al.*, 2017), traffic congestion and speed assessment using image processing technology (Caprio *et al.*, 2018) are examples. However, their main concerns were on the technical aspects again. Only the paper by Zakaria *et al.* (2017) that studied the issue from users' perspective and not the technical aspect.

In the context of Myanmar, all studies returned from Scopus search were focused on technical aspects. The papers presented implementation of particular technologies to enable the city to be 'smarter' (e.g. the implementation of automatic vehicle license plate recognition system for smart transportation (Lin *et al.*, 2018)) or studied methods promoting more efficiency in particular systems (e.g. an efficient method of optimal routing system for transportation proposed by Soe and Thein (2018)).

Although research related to Smart city in Cambodia, Laos, and Timore-leste papers were not found in the Scopus database, the researcher did additional search in Google Scholar and found few studies attempting to report several technologies implementation and adoption in Timor-leste. For example, Chandra and McNamara (2018) have reported an initiative to implement climate-smart agriculture compared with that of Philippines (as they were both two Australian Aid-funded community-based adaptation programs from 2012 to 2015). The researchers highlighted a combination of multi-level, multi-actor processes and activities that enabled the two cases to integrate adaptation, mitigation and food security outcomes. Papers that were studied in Timor-leste mainly concern climate change/control issues due to the location of the country.

CONCLUSION

This paper attempts to understand what have been researched in an area of smart city and also to identify gaps. Therefore, it selected the existing literature from Scopus database, using smart city and digital technology as search keywords. Only publications (including proceedings and journal papers) from 2010 to 2020 were extracted. The analysis of the literature looked at the definition and scope of the smart city. Keywords often used were derived to see overall pictures and focuses of the past literature. Then, the business, organisational and technical framework adopted in Laudon and Laudon (2017) was used as an analytical lens to see what have been done and highlight the gap that should be addressed in the future. Additionally, smart city research that were conducted in the context of Southeast Asia countries were also examined. The region was specifically selected due to its nature and regional trend that a number of cities are and have been urbanizing rapidly.

The definition and wide-range scope of smart city has substantiated its own importance and the need to study the area from several aspects (apart from technological aspects). The analysis of the selected literature showed that technological aspects are relatively better studied than business and organisational aspects. This is coherent with observation by Lopes (2017). The author mentioned that the majority of literature focused on technical aspects as information and communication technologies were the backbone of smart city initiatives. However, the author also pointed out that other aspects of smart city, such as governance, should be taken into consideration and need to be studied further. For the selected literature that have been categorised as business-related, business models, ecosystems, success factors and failures in implementing smart city, and how to manage a smart city from the new data (that the city can never access before) were the main issues studied in the previous literature. However, smart city transformation processes are complex and involve a number of stakeholders; the issue still requires much more in-depth studies. Social organization wise, only few studies attempted to understand the relevant issues. Changing culture, social relationship, roles of citizen, relationship between government or city manager and citizen, quality of life, condition, structures of power, structures of the society and organisations are yet to be explored and better understood.

The numbers of publications that focused on Southeast Asia region are surprisingly low. Studies in Singapore were found highest in terms of numbers, while no smart city research papers were found related to Laos, Cambodia, and Timor-leste. The analysis of the literature in this group showed similar trend when compared with the bigger pool of smart city literature reviewed in the first part of this paper. The literature that was specific to Southeast Asia were more about technical aspects. Research concerning smart city policy and smart governance policy seemed to get relatively higher attention within this group of literature, yet the number was still very low. Policy discussions and comparisons were seen in Singapore, Thailand, Malaysia, and Indonesia. This is perhaps because these countries have the higher number of big or medium-sized cities compared to other countries in the same region.

It is important to note that literature included in this study is only limited to those that are listed in Scopus database. Therefore, the result might not represent the whole reality nor cover all the studies that have been published. However, since Scopus is one of the most widely-used research databases, the results in this study should at least provide a quick jumpstart into the field, which is the main purpose of this paper.

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Analysis of the Interactive Strategy of Microblog for Snack Food Enterprises

(Full Paper)

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ABSTRACT

With the development of economic conditions and consumption patterns, snack foods have become the first choice in people's daily diet and consumption, while the market scale is rising, snack foods have also gained high public opinion attention. The existing research results show that the micro-blog interaction effect will positively affect the sales performance, but there are few characterization studies on the effective micro-blog interaction strategy of the snack food enterprises. In this paper, the typical snack food enterprises as an example, mainly through the network crawler to collect micro-blog interactive contents, text analysis, and finally through ANOVA analysis to study the effect of different interaction strategies. The research finds that the strategy of micro-blog interaction of snack food enterprises is better. The characteristic research results of this paper possibly provide reference and enlightenment for the future research of micro-blog interaction strategy of snack food enterprises.

Keywords: Microblog; Snack food enterprises; Interaction strategy; ANOVA analysis.

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INTRODUCTION

Snack foods belong to the category of fast-moving consumer goods. They are foods that people eat during their leisure and rest. The main categories include: dried fruits, puffed foods, candy, and meat products. With the development of the economy and the improvement of consumption levels, snack foods are gradually becoming consumers' daily necessities, and have gained high public opinion concerns. In 2018, the scale of China's snack food industry reached 990 billion yuan. With the rapid spread of mobile Internet and the prosperity of e-commerce, sales of snack food online have also emerged. In 2018, the sales of China's snack food e-commerce market was 62.31 billion yuan, and it is expected to reach 96.4 billion yuan in 2020 (iiMedia Research, 2019). In 2017, the Central Document No. 1 issued by the Central Government of China formulated specific guidelines for supporting and strengthening the development of e-commerce for agricultural products (Ministry of Agriculture, 2017), further boosting the development of snack food e-commerce.

The rapid development of Web 3.0 technology has spawned a large number of Internet social media, affecting consumers' strong demand for interaction (Baumöl, Hollebeek et al., 2016), which has narrowed the distance between e-commerce and social media. Scholars have found through empirical analysis that social media will have a positive impact on sales (Kim & Kim, 2018), and brand equity (Kim, 2010; Eun-Ju Seo & Jin-Woo Park, 2018). According to the survey, 93% of social media users believe that companies should use social media in their business, while 85% believe that companies should interact with customers through social media sites (Michaelidou et al., 2011). Eun-Ju Seo & Jin-Woo Park (2018) found that consumers are more inclined to trust information on social media than on advertising. In China, Sina Weibo is increasingly integrated into people's daily lives as an important social communication platform. As of December 2018, Sina Weibo's monthly active users reached 462 million, of which the average number of daily active users reached 200 million (Sina Weibo's fourth quarter earnings report, 2018). Due to its interactive advantages, Micro-blog continues to attract more and more companies to register Micro-blog accounts to promote brands and products, retain old customers and attract new customers, and improve sales efficiency. Among them, Three squirrels and BESTORE have emerged as a group of excellent agricultural products e-commerce companies.

However, marketers often cannot use the company's Micro-blog content to form a good marketing interaction with consumers. There are few related researches on effective microblog interaction strategies for snack food companies. This paper takes a typical leisure food enterprise as an example, mainly collects microblog interactive content through web crawler, analyzes the text, and finally studies the effect difference of different interactive strategies through variance analysis, which is used by the snack food enterprise marketers in implementing the microblog interaction strategy.

LITERATURE REVIEW

Social media has changed the way people communicate (Meng, Zhang et al., 2016) and has become an increasingly popular marketing tool. microblog is a representative tool for social media, which affects marketing effectiveness, and it has always been a hot topic in academic discussion (Schultz, 2016). microblog interactive marketing has a significant positive impact on the company's brand reputation and marketing performance (Tayal & Komaragir, 2009).

The classification of interactive strategies mainly focuses on frequency, form, direction and content. Among them, classification according to content is the main classification standard of microblog interactive strategy. Based on content classification, scholars mainly study from the perspective of interaction style and influence strategy (Yan & Chang, 2013). According to the difference of interaction style, Sheth (1976) divides the interaction strategy into three types: task-oriented, interactive-oriented and self-oriented. Köhler et al. (2011) also proposes a similar classification based on the differences in interaction styles. It is believed that the types of interaction strategies mainly include social interaction and task-oriented interaction. Social interaction refers to the communication between the two parties mainly involves the information content of the social level. Task-oriented interaction is mainly embodied in specific business information, and it is pointed out that the two interaction strategies have a significant impact on consumer adaptability and corporate performance. Yan & Chang (2013) followed the classification criteria of scholars such as Köhler (2011) and further defined each type: the purpose of social interaction is to satisfy the emotional needs of consumers and to establish and enhance good social relations between the two parties. Task-oriented interaction is to enable consumers to quickly and easily understand the company and products, and to stimulate consumers and enterprises to create value together. Using grounded theory, the social interaction content is subdivided into three categories: general knowledge, professional knowledge and emotional communication; the task-oriented interactive content is subdivided into three categories: product interaction, corporate image interaction and co-creation activities, and confirms social interaction. The strategy has a positive effect on the consumer's emotional and relevance perception, and the task-oriented interactive strategy has a positive effect on the positive word-of-mouth communication of the enterprise. In view of the degree of academic recognition and the particularity of the research sample, this study refers to the classification criteria of microblog interactive content strategy based on the differences in microblog interaction styles between Köhler et al. (2011) and Yan & Chang (2013).

The effect of microblog interactive strategy is a direct criterion for measuring the effectiveness of microblog interactive strategy (Bi, Zhang & Zuo, 2013). Scholars mainly study the effect of microblog interactive marketing through repost number, number of comments and likes. [8] From the perspective of interactive strategy, the interactive effect of microblog content can analyze the impact of each interactive strategy on consumer differentiation, so as to help enterprises create more interactive scenarios and propose effective marketing strategies. In view of the actual needs and significance of the research, this paper based on the type of corporate microblog interactive content strategy, using the number of forwards, comments and points of praise directly related to the microblogging interaction strategy to evaluate the effectiveness of the interactive strategy.

RESEARCH METHODOLOGY

Research Sample

This article takes the official microblog of three leisure food companies in Sina Weibo as the research object, and the three companies are Three squirrels, Baicaowei, BESTORE. The three sample companies are ahead of other brands of the same type in terms of sales volume and brand awareness, and have a large number of fans in Sina Weibo. The company operates official microblog daily to maintain positive interaction with consumers. Therefore, in order to study the effectiveness of the microblog interactive strategy of the snack food company, Three squirrels, Baicaowei, and BESTORE are more representative.

This research mainly collects Sina Weibo data of sample enterprises through web crawlers. To ensure the stability of the experimental data and reduce the interference of extreme values, the microblog data is first cleaned. Using box plots in SPSS to eliminate likes, comments, or forward an excessive number of microblogs, and eliminate duplicates or incomplete microblog samples. Finally, after the data was cleaned, 33,195 effective microblogs were obtained from three sample companies, including 10147 for Three squirrels, 8918 for Baicaowei, and 14,130 for BESTORE. Subsequent data processing will use 33,195 microblogs after data cleaning as research samples.

Research Design

This study mainly uses content analysis and analysis of variance for sample data to study the relationship between the interactive strategy of snack food microblogging and the effectiveness of consumer interaction. Content analysis is a scientific research method that combines objective, systematic and qualitative and quantitative information that can be exchanged. In this study, the machine language learning classifier was used to quantify the microblog content of the snack food enterprise, and then the variance research was analyzed.

It should be emphasized that the core research part is to make a classifier for machine language learning through python3.7, and use 480 pieces of microblog data classified by manual coding as a training set. The specific coding rules are based on the analysis framework of the enterprise microblog interactive content strategy type. In this paper, the content of the enterprise microblog is extracted and quantified, respectively, "1 = general knowledge", "2 = emotional communication", "3 = product interaction", "4 = corporate image interaction" and "5 = cocreation activities", and enter the number of repost and number of comments of the enterprise's microblog content. After many tests, 33,195 effective microblogs were processed in machine language to realize the classification of microblog interactive strategies. The test showed that the effective classification of classifiers was up to 83.78%.

DATA ANALYSIS AND RESULTS

Descriptive Statistics

There are significant differences in the implementation of microblog interactive content strategies among the three leisure food companies. Through the classification and summary statistics of the social interaction strategy and task-oriented interaction strategy in the sample enterprise microblog, the general situation of the enterprise microblog in implementing the interactive content strategy is shown in Table 1:

Table 1: Implementation of microblog Interactive Strategy for Leisure Food Enterprises

Microblog interaction strategy types	Three squirrels		Baicaowei		BESTORE		
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	
Sociality	General knowledge	3040	29.96%	1834	20.57%	5493	38.87%
	Emotional communication	146	1.44%	397	4.45%	885	6.26%
Task-oriented	Product interaction	388	3.82%	3697	41.46%	1419	10.04%
	Corporate image interaction	433	4.27%	681	7.64%	783	5.54%
	Cocreation activities	6140	60.51%	2309	25.89%	5550	39.28%
Total	10147	100%	8918	100%	14130	100%	

According to Table X, Three squirrels's microblog content interaction strategy is mainly based on task-oriented cocreation activities, accounting for more than 60% of the number of historical effective microblogs; while the social interaction strategy accounts for only 1.44% of emotional communication. Compared with Three squirrels, Baicaowei's strategy is based on task-oriented, but cocreation activities only account for 25.89%, and the most used strategy is product interaction, reaching 41.46%. In the implementation of BESTORE microblog content interaction strategy, the general knowledge category of social strategy category accounted for 38.87%, which is close to the correlation activity of 39.28% of task-oriented strategy. It can be seen that the three representative sample companies also have different focuses on the interactive strategy of microblog content.

From the descriptive statistics of the number of reposts, number of comments and number of likes of the three companies (Table 2, Table 3, Table 4), from the descriptive statistics, The average number of forwarding numbers, comments, and likes in the corporate microblog social strategy of the three squirrels is relatively close. The number of co-creation activities, the number of comments, and the number of likes in the task-oriented strategy are the highest. The average number of repost and number of likes of the general knowledge of Baicaowei's corporate microblogging social strategy is 63.65 and 95.26 respectively. In the task-oriented strategy, the number of co-creation activities, the number of comments, and the number of likes are the highest. The mean value of the variables in BESTORE's corporate microblog social strategy is relatively close. In the task-oriented strategy, the number of comments of the comparison activities is the highest, reaching 44.9. It can be seen that consumers are more inclined to task-oriented interactive behavior. In social strategies, consumers' preference for general knowledge and emotional communication is less.

Table 2: Descriptive statistics for Three squirrels

Variable	Statistical indicators	Sociality			Task-oriented	
		General knowledge	Emotional communication	Product interaction	Corporate image interaction	Cocreation activities
Repost	Mean	20.61	30.25	19.38	25.53	123.39
	Standard deviation	198.634	206.551	76.779	143.12	533.011
	N	3040	146	388	433	6140
Comment	Mean	50.77	41.95	39.12	53.54	118.61
	Standard deviation	151.319	71.004	111.223	192.691	325.2
	N	3040	146	388	433	6140
Likes	Mean	106.16	106.51	69.1	105.69	121.22
	Standard deviation	231.655	303.846	122.38	266.155	260.3
	N	3040	146	388	433	6140

Table 3: Descriptive statistics of Baicaowei

Variable	Statistical	Sociality	Task-oriented
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	indicators	General knowledge	Emotional communication	Product interaction	Corporate image interaction	Cocreation activities
Repost	Mean	63.65	19.31	81	41.72	132.19
	Standard deviation	400.784	66.085	442.111	258.267	456.699
	N	1834	397	3697	681	2309
Comment	Mean	35.84	41.91	42.28	32.86	96.55
	Standard deviation	98.179	57.281	161.441	183.498	266.201
	N	1834	397	3697	681	2309
Likes	Mean	95.26	63.13	77.1	56.02	97.03
	Standard deviation	309.205	139.429	271.465	243.125	281.887
	N	1834	397	3697	681	2309

Table 4: Descriptive statistics for BESTORE

Variable	Statistical indicators	Sociality			Task-oriented	
		General knowledge	Emotional communication	Product interaction	Corporate image interaction	Cocreation activities
Repost	Mean	7.31	5.04	32.25	1.73	33.39
	Standard deviation	88.782	26.716	388.657	15.869	213.084
	N	5493	885	1419	783	5550
Comment	Mean	14.26	14.58	20.06	15.32	44.9
	Standard deviation	27.058	26.635	74.507	48.797	158.879
	N	5493	885	1419	783	5550
Likes	Mean	13.63	10	18.25	8.64	21.07
	Standard deviation	33.76	10.654	139.058	12.781	115.562
	N	5493	885	1419	783	5550

Analysis Of Variance

This study used one-way ANOVA to try to explore the effect difference between the number of praises, the number of reposts and the number of comments generated by the enterprise microblog interaction strategy of various products. Before the one-way analysis of variance, the homogeneity test of variance is required. Through the test of the homogeneity of variance at different levels, the specific results are shown in Table 5:

Table 5: Variance Homogeneity Test Results

Sample company	Dependent Variable	Levene	df1	df2	Sig.	Whether the Homogeneity
Three squirrels	repost	111.061	4	10142	0	No
	comment	103.138	4	10142	0	No
	likes	17.533	4	10142	0	No
Baicaowei	repost	33.629	4	8913	0	No
	comment	97.35	4	8913	0	No
	likes	12.985	4	8913	0	No
BESTORE	repost	61.375	4	14125	0	No
	comment	129.73	4	14125	0	No
	likes	21.335	4	14125	0	No

It can be seen from the test results that the three-squirrels enterprise microblog interaction strategy content produces repost Levene statistic=111.061, $P<0.05$; comments Levene statistic = 103.138, $P<0.05$; likes Levene statistic=17.533, $P < 0.05$. Baicaowei's corporate microblogging interactive strategy content generated repost Levene statistic = 33.629, $P < 0.05$; comments Levene statistic = 97.35, $P < 0.05$; likes Levene statistic = 12.985, $P < 0.05$. BESTORE's corporate microblogging interactive strategy content generated repost Levene statistic = 61.375, $P < 0.05$; comments Levene statistic = 129.73, $P < 0.05$; likes Levene statistic = 21.335, $P < 0.05$. Therefore, it is considered that there are significant differences in the microblog data of the three companies at different levels, which violates the assumption of homogeneity of variance.

Through the one-way analysis of variance of the three companies, the specific analysis results are shown in Table 6, Table 7, and Table 8.

Table 6: ANOVA test results (Three squirrels)

Dependent Variable		Statistics index	df	Mean Square	F	sig.
Repost	Between Groups	25258776.77	4	6314694.192	34.042	0
	Within Groups	1881315845	10142	185497.52		
	Total	1906574621	10146			
Comment	Between Groups	11601940.32	4	2900485.081	39.732	0
	Within Groups	740372970.4	10142	73000.687		
	Total	751974910.7	10146			
Likes	Between Groups	1327049.971	4	331762.493	5.351	0
	Within Groups	628825625	10142	62002.132		
	Total	630152675	10146			

Table 7: ANOVA test results (Baicaowei)

Dependent Variable		Statistics index	df	Mean Square	F	sig.
Repost	Between Groups	9025149.735	4	2256287.434	13.014	0
	Within Groups	1545334181	8913	173379.803		
	Total	1554359331	8917			
Comment	Between Groups	5654056.143	4	1413514.036	41.753	0
	Within Groups	301745713.4	8913	33854.562		
	Total	307399769.5	8917			
Likes	Between Groups	1505715.182	4	376428.796	4.942	0.001
	Within Groups	678907106.3	8913	76170.437		
	Total	680412821.5	8917			

Table 8: ANOVA test results (BESTORE)

Dependent Variable		Statistics index	df	Mean Square	F	sig.
Repost	Between Groups	2548955.141	4	637238.785	17.64	0
	Within Groups	510264233	14125	36124.901		
	Total	512813188.1	14129			
Comment	Between Groups	2980456.859	4	745114.215	68.142	0
	Within Groups	154452422.7	14125	10934.685		
	Total	157432879.6	14129			
Likes	Between Groups	251117.438	4	62779.36	8.21	0
	Within Groups	108012515.4	14125	7646.904		
	Total	108263632.8	14129			

Through the ANOVA results, it can be seen that Three squirrels's enterprise microblog content interaction strategy generated the number of forwarding was $F=34.042$, $P<0.05$; the number of comments was $F=39.732$, $P<0.05$; the number of points was $F=5.351$, $P<0.05$. And it can be seen that Baicaowei's enterprise microblog content interaction strategy generated the number of forwarding was $F=13.014$, $P<0.05$; the number of comments was $F=41.753$, $P<0.05$; the number of points was $F=4.942$, $P<0.05$. And it can be known that Baicaowei's enterprise microblog content interaction strategy generated the number of forwarding was $F=17.64$, $P<0.05$; the number of comments was $F=68.142$, $P<0.05$; the number of points was $F=8.21$, $P<0.05$.

It can be seen from the results that there are significant differences in the number of reposts, comments, and likes of the three microblog interactive content strategies at different levels, which requires further multiple comparisons, but at different levels. The data violated the homogeneity hypothesis of variance, so this study used four different comparative statistical methods: Tamhane test, Dunnett T3 test, Games-Howell test and Dunnett C test without assumption of homogeneity of variance.

The conclusions of the four sample tests by different sample companies are consistent. The Tamhane test results of three squirrels are shown in Table 9:

Table 9: Tamhane test results (Three squirrels)

Dependent Variable	tactics (I)	tactics (J)	Average difference (I-J)	Standard error	Sig.	95% Confidence interval		
						Lower	Upper	
Repost	1	2	-9.637	17.47	1	-59.24	39.96	
		3	1.228	5.308	1	-13.66	16.11	
		4	-4.922	7.764	0.999	-26.73	16.88	
		5	-102.785*	7.697	0	-124.34	-81.23	
	2	1	9.637	17.47	1	-39.96	59.24	
		3	10.865	17.533	1	-38.91	60.64	
		4	4.715	18.426	1	-47.46	56.9	
	3	5	-93.148*	18.398	0	-145.25	-41.05	
		1	-1.228	5.308	1	-16.11	13.66	
		2	-10.865	17.533	1	-60.64	38.91	
	4	4	-6.15	7.906	0.997	-28.36	16.06	
		5	-104.013*	7.84	0	-125.97	-82.05	
		1	4.922	7.764	0.999	-16.88	26.73	
	5	2	-4.715	18.426	1	-56.9	47.46	
		3	6.15	7.906	0.997	-16.06	28.36	
		5	-97.863*	9.673	0	-124.98	-70.74	
	Comment	1	1	102.785*	7.697	0	81.23	124.34
			2	93.148*	18.398	0	41.05	145.25
			3	104.013*	7.84	0	82.05	125.97
			4	97.863*	9.673	0	70.74	124.98
2		2	8.816	6.486	0.855	-9.53	27.16	
		3	11.649	6.278	0.484	-5.99	29.29	
		4	-2.77	9.658	1	-29.93	24.39	
3		5	-67.839*	4.976	0	-81.77	-53.91	
		1	-8.816	6.486	0.855	-27.16	9.53	
		3	2.833	8.149	1	-20.11	25.77	
4		4	-11.586	10.967	0.968	-42.41	19.24	
		5	-76.654*	7.194	0	-96.93	-56.38	
		1	-11.649	6.278	0.484	-29.29	5.99	
5		2	-2.833	8.149	1	-25.77	20.11	
		4	-14.42	10.846	0.869	-44.88	16.04	
		5	-79.488*	7.008	0	-99.15	-59.82	
Likes		1	1	2.77	9.658	1	-24.39	29.93
			2	11.586	10.967	0.968	-19.24	42.41
			3	14.42	10.846	0.869	-16.04	44.88
			5	-65.068*	10.148	0	-93.58	-36.56
	2	1	67.839*	4.976	0	53.91	81.77	
		2	76.654*	7.194	0	56.38	96.93	
		3	79.488*	7.008	0	59.82	99.15	
	3	4	65.068*	10.148	0	36.56	93.58	
		2	-0.357	25.495	1	-72.78	72.06	
		3	37.061*	7.5	0	16.01	58.12	
	4	4	0.47	13.463	1	-37.38	38.32	
		5	-15.061*	5.356	0.048	-30.06	-0.06	
		1	0.357	25.495	1	-72.06	72.78	
	5	2	37.418	25.903	0.804	-36.09	110.93	

	4	0.828	28.213	1	-78.94	80.6
	5	-14.703	25.365	1	-86.78	57.37
3	1	-37.061*	7.5	0	-58.12	-16.01
	2	-37.418	25.903	0.804	-110.93	36.09
	4	-36.591	14.22	0.098	-76.54	3.36
	5	-52.122*	7.045	0	-71.91	-32.33
	1	-0.47	13.463	1	-38.32	37.38
4	2	-0.828	28.213	1	-80.6	78.94
	3	36.591	14.22	0.098	-3.36	76.54
	5	-15.531	13.215	0.936	-52.69	21.63
	1	15.061*	5.356	0.048	0.06	30.06
5	2	14.703	25.365	1	-57.37	86.78
	3	52.122*	7.045	0	32.33	71.91
	4	15.531	13.215	0.936	-21.63	52.69

* The significance level of the mean difference is 0.05.

At the level of significance of 0.05, on the one hand, the three squirrels enterprise microblog content interaction strategy number of repost, general knowledge (20.61), emotional communication (30.25), product interaction (19.38), corporate image interaction (25.53) and respectively $P < 0.05$ for cocreation activities (123.39), with significant differences; On the other hand, under number of comments, general knowledge (50.77), emotional communication (41.95), product interaction (39.12), and corporate image interaction (53.54) were significantly different from those of cocreation activities (118.61), $P < 0.05$; Finally, under number of likes, there was a significant difference between $P < 0.05$ for general knowledge (106.16) and product interaction (69.1), cocreation activities (121.22), $P < 0.05$ for product interaction (69.1) and cocreation activities (121.22).

The same method tests the effectiveness of Baicaowei and BESTORE's microblog interaction. Under the number of repost of Baicaowei enterprise microblog content interaction strategy, general knowledge and emotional communication, cocreation activities were $P < 0.05$, significantly; emotional communication and general knowledge, product interaction, and cocreation activities were $P < 0.05$, significantly; product interaction and significant communication, corporate image interaction, and cocreation activities were $P < 0.05$, significantly; corporate image interaction and product interaction, cocreation activities $P < 0.05$, significant. Under number of comments, cocreation activities and general knowledge, emotional communication, product interaction, and corporate image interaction were $P < 0.05$, which was significant. Under number of likes, general knowledge and emotional communication, corporate image interaction were $P < 0.05$, significantly; emotional communication and general knowledge, cocreation activities were $P < 0.05$, significantly; corporate image interaction and general knowledge, cocreation activities were $P < 0.05$, significantly.

Under the number of repost of BESTORE enterprise microblog content interaction strategy, corporate image interaction and general knowledge, emotional communication, product interaction, and cocreation activities were $P < 0.05$, which was significant; the cocreation activities and the general knowledge, emotional communication, and corporate image interaction were $P < 0.05$, which was significant. Under number of comments, general knowledge and product interaction, cocreation activities were $P < 0.05$, significantly; it is worth noting that cocreation activities and other strategies are significant. Under number of likes, general knowledge and corporate image interaction, correlation activities were $P < 0.05$, significantly; product interaction and general knowledge, coordination activities were $P < 0.05$, significantly; corporate image interaction and general knowledge, cocreation activities were $P < 0.05$, significantly.

The results show that there are differences in the effects of the spread of microblog content interaction strategies among the three leisure food companies. Companies need to pay attention to the differences in interaction effects under different strategies. It can be seen from the above results that cocreation activities generally have good interaction effects in enterprise microblogs, which means that enterprises have important significance in the application of task-oriented strategies.

CONCLUSION AND RECOMMENDATION

Research Conclusions

This paper studies the effects of microblog interactive content strategy of three representative leisure food enterprises. Through the statistical analysis of the research samples, the following specific conclusions can be obtained: First, there are differences in the types of microblog interactive content strategies among the three leisure food companies. From the research data, the three companies often adopt task-oriented strategies. When adopting microblog interactive content strategy, enterprises potentially enhance consumer attention and interaction through more product interaction and joint creation activities. Second, the study found that cocreation activities and other interaction strategies are often more significant in number of reposts, number of comments, and number of likes. Therefore, companies should give priority to the use of cocreation activities in order to achieve good interaction. The general knowledge in social strategies can also achieve better results. This may be because general knowledge conveys non-product information to users and enhances consumers' interest in understanding products. Third, as an Internet leisure food enterprise, the rational use of the interactive strategy of enterprise microblogging is

likely to have an impact on consumers directly. Enterprises should pay more attention to the microblog interaction strategy.

Limitation And Future Work

The main limitation of this paper is that only three representative e-commerce and leisure food enterprises have been collected. Four kinds of post-multiple test methods are used to obtain consistent experimental data and explore the differences of interactive content strategies. In order to make the research results more precise and more practical, the future research can be based on more sample companies and research on enterprise microblogs from more perspectives, and then, the microblog operation of the e-commerce enterprise is more efficient.

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Application Status and Development Suggestions of Internet Personal Credit Investigation

(Full Paper)

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ABSTRACT

The development of Internet finance has given birth to the Internet credit investigation industry, which has expanded the application scenarios of personal credit information from credit finance to credit life. Starting with the current development of personal credit investigation on the Internet in China, this paper introduces the typical enterprises of personal credit investigation on the Internet in China and the application scenarios of credit information. It further points out the problems of the internet personal credit reporting industry through the analysis of the industrial chain and proposes solutions.

Keywords: Internet credit investigation, Personal credit registry, Credit life.

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DEVELOPMENT OF CHINA'S INTERNET PERSONAL CREDIT REPORTING INDUSTRY

China's credit reporting agency was first established in 1932 as the "China Credit Information Office". However, the substantial development of the credit investigation industry did not begin until the reform and opening up. Later, the 16th National Congress and the 18th National Congress announced the strategic goals and specific requirements of building a social credit system. The "Regulations on the Management of Credit Information Industry" was implemented on March 15, 2013 (Credit Reference Center of the People's Bank of China, 2014). Since then, China's credit information industry has advanced in leaps and bounds in the legal system construction.

The main enterprises in the credit information industry chain can be classified into two types of businesses, corporate credit information business and personal credit information business. They collect and process corporate credit information and personal credit information to provide information services to users.

Despite that China's credit information industry started early, the personal credit coverage rate appears low. The three major credit agencies in the United States, EXPERIAN, Equifax, and Trans Union, cover over 90% of the population in the United States. The emerging credit reporting agencies, such as Credit Karma and Zest Finance, complement traditional credit reporting system by covering the rest of the market (Chyxx, 2016). China's credit information industry has a two-wheel-drive development model of "government plus market" (Credit Information System Bureau of the People's Bank of China, 2018). Statistics from People's Bank Credit Information Center showed that, in 2012, the number of natural persons recorded in China's personal credit information system was 820 million, and the number reached 880 million in 2015 (Credit Reference Center of the People's Bank of China, 2015). On March 10, 2019, Chen Yulu, deputy governor of the central bank, told the Chinese and foreign journalists that 990 million natural persons have been recorded in China's credit information system, and the number of daily inquiries of personal credit reports reached 5.55 million. The number of daily inquiries increased by 221%, and the compound annual growth rate exceeded 47% compared with the daily average number of inquiries in 2015.

In terms of service groups, the US credit industry has started earlier, and its product services cover the entire life cycle of people. On the contrary, China's credit information is mainly used by licensed financial institutions, for loan services. As people's daily lives are increasingly integrated with the Internet, the Internet personal credit behaviors provide valuable credit data which is not recorded in traditional bank credit records. The ballooning size of the Internet financial market and the escalating credit risks have boosted the market demand for personal credit investigation business.

The demand in China's market can be seen from the consumer credit balance. As a financial application scenario for personal credit reporting, consumer credit is a loan for an individual or family of consumers to purchase durable goods or to pay for other personal or household consumption. China's consumer credit market balance is rising, maintaining a growth rate of about 20%. Also, the market has a huge demand for the application of credit data in life services.

In January 2015, the People's Bank of China issued a document, requiring eight institutions, including Sesame Credit Management Co., Ltd. and Tencent Credit Investigation Co., Ltd., to start a personal credit investigation business (People's Bank of China, 2015). This is the first attempt by Chinese regulators to launch a market-based personal credit service.

In 2018, the People's Bank of China approved the establishment of Baihang Credit Information Co., Ltd., China's first market-oriented personal credit investigation agency (Baihang Credit, 2018). Among all the shareholders of Baihang Credit Information Co., Ltd., the China Internet Finance Association holds 36% of the shares, and eight institutions including Sesame Credit and Tencent Credit each hold 8% of the shares (CREDITCHINA.GOV.CN, 2018).

In October 2018, the People's Bank of China stated that it would issue personal credit information licenses prudently to promote the coordinated development of the first market-oriented personal credit reporting agency - Baihang Credit Information Co., Ltd. and help the Credit Information Center of the People's Bank of China to expand the coverage of personal credit information in China. The expansion of the coverage of personal credit information will reduce the overall risk of Internet finance and e-commerce and promote the healthy development of these industries. On January 10, 2019, the People's Bank of China issued the "Guide to the Service for the Examination and Approval of Credit Information Agencies of Individual Credit Information Business", which elaborated on the conditions for the establishment and approval of individual credit reporting agencies in China (CREDITCHINA.GOV.CN, 2019).

CHINA'S INTERNET PERSONAL CREDIT REPORTING SYSTEM AND ITS CHARACTERISTICS

China's Internet Personal Credit Reporting System

China's personal credit reporting system can be divided into three parts: credit data sources, credit information processing enterprises, and credit information users. The credit data is collected from data sources. After the collection and analysis of credit information processing enterprises, credit information services will be provided for users.

As the core of the personal credit reporting system, credit information processing enterprises not only undertake the task of data collection, but also have to prove the authenticity of the data through cross-validation. Therefore, credit information processing enterprises need to obtain data from different sources to achieve the cross-validation function between different data sets.

Personal basic information, personal credit information, Internet credit data and other information reflecting credit status are China's personal credit data sources. The credit center of the People's Bank of China, private credit reporting agencies, and Baihang Credit Information Co., Ltd. are credit information processing enterprises. The main application scenarios of using credit information are financial scenarios including banks, licensed credit departments and Internet financial institutions. In addition, there are life application scenarios for public utilities, public sectors, and other innovative application scenarios. The financial application scenario and life application scenario of personal credit information together constitute a rich usage scenario of credit information.

Internet personal credit reporting enterprises refer to enterprises that use personal credit information on the Internet as one of their data sources. This paper will introduce the credit data processing enterprises and information application scenarios in the third and fourth parts.

Characteristics Of Internet Personal Credit Reporting Business

Diverse data dimensions

Traditional personal credit data mainly comes from personal financial transactions of financial institutions. These data have low dimensions and insufficient coverage, and there is a large gap in credit data, which is not conducive to the stable development of the financial system. Internet personal credit information integrates multi-dimensional data such as personal consumption, living, and relationships, and combines traditional credit information to jointly build a more comprehensive portrait of user credit information. The Internet personal credit service has greatly improved the coverage of credit data, reduced system risks, and improved financial efficiency. At the same time, it has also facilitated individuals to obtain their own credit reports and provided a more comprehensive credit service.

Diverse data structures

Different from the structured financial data submitted by traditional financial institutions, Internet personal credit reporting business has added non-structured data dimensions such as user consumption data, individual behavior preference data, and interpersonal relationship data. Internet personal credit data more accurately depicts the user's credit portrait. While improving the coverage of personal credit data and the credibility of credit results, Internet personal credit reporting business also puts forward higher requirements for the integrated processing capabilities of credit data. The development of big data, cloud computing, machine learning and other data processing technologies has laid the foundation for the advancement of Internet credit.

Emerging data processing technologies

With the integration of the Internet and daily life, more and more traces of residents have left on the Internet. This makes it possible for personal Internet credit reporting enterprises to obtain a variety of personal credit data, but at the same time it also increases the cost of data identification, extraction, and consolidation. Therefore, one of the most important differences between Internet credit reporting business and traditional credit reporting business is that Internet credit reporting business

requires a higher requirements for data processing technology. Big data and intelligent algorithms are commonly used in the Internet credit reporting industry to deal with the complex network of information clusters (Xiao-Lin Li & Yu Zhong, 2012).

Different participants in the industry chain

In the traditional personal credit reporting business, banks and other financial institutions collect personal credit data and submit it to the personal credit database of the People's Bank of China. The credit reporting center of the People's Bank of China provides financial institutions with personal credit data query services. However, in the Internet credit reporting business, personal credit information providers accumulate personal credit data through their own channels, and hand them to credit information processing enterprises after preliminary cleaning. The credit information processing enterprises then establish personal credit portraits and provide services to credit information users. Therefore, the core participant in traditional personal credit reporting business is the credit reporting center of the People's Bank of China, and the core participant in Internet credit reporting are credit information processing enterprises.

Comprehensive credit services

Traditional personal credit reporting services are mainly for financial institutions. The personal credit reporting center of the People's Bank of China provides personal credit information to banks and other financial institutions to reduce systemic risks and improve the efficiency of financial transactions. Credit information processing enterprises in Internet credit reporting not only provide services to banks and other financial institutions, but also provide personal credit data query services to public utilities, the public sector, and other enterprises. In addition, in the era of Internet personal credit reporting, individuals can obtain credit information services such as credit report inquiry, credit certification, and asset certification, which improves the use scenario and value of credit information.

PERSONAL CREDIT INFORMATION PROCESSING ENTERPRISES

Enterprises Starting Personal Credit Reporting Services

The People's Bank of China issued the "Notice on Preparing for Personal Credit Information Business" in 2015. Table 1 lists the credit data sources, credit evaluation dimensions, credit reporting services provided by eight companies starting credit reporting business and their industries.

Table 1: The Basic Information of Companies Developing Personal Credit Reporting System

Name	Basic data source	Evaluation dimension	Services	Industry
Sesame Credit Management	E-commerce transaction data, online financial data, data from public institution, data of business partners, data uploaded from users	Credit history, behavioral preferences, personality traits, levels of commitment, interpersonal relationship	Travel, accommodation, finance, shopping, social and daily activities	Internet
Tencent Credit Information	User's historical data on WeChat and QQ	Commitment history, security, wealth, Spending habits, Socializing status	Anti-fraud, credit assessment, personal credit application, risk alert, post-loan management	Internet
Shenzhen Qianhai Credit Information Center	Ping An Group's integrated data, external data partners, bad credit data reported by cooperative financial institutions	Risk of breach of trust, behavior characteristics, personality characteristics, performance, consumption preference, social credit, growth potential	Personal credit score inquiry, Anti-fraud products, credit risk identification, data access, consulting services, intelligent technology	Insurance
Peng Yuan Credit	Collect data from third parties with user authorization	Credit history, behavioral habits, personality characteristics, earning capacity, asset and wealth, public evaluation	Identity authentication, credit verification, credit report, credit score, anti-fraud, automatic risk alert	Credit reporting

China Chengxin Credit	Open-source web crawling, data exchange with customers, data procurement, user authorization	Credit history, behavioral traits, identity attributes, performance, social data, public record	Personal credit score, personal credit report, credit authentication, risk information inquiry, Internet authentication services	Credit reporting
China Zhicheng Credit	P2P lending and Internet financial institutions with anti-fraud cloud platform	Credit history, credit activity, personality characteristics, performance, consumer credit	Personal credit score, anti-fraud services, identity authentication, credit monitoring	Credit reporting
Koala Credit	Bank transfer, credit card repayment and other services, direct access to personal credit and debit card data; data support from shareholders and public sectors; other industrial cooperation data	Credit history, transaction behavior, identity attributes, performance, social relations	Koala individual credit score, credit certification, credit information query	Startup with data resources
Beijing Huadao Credit	Bank credit data, public security and justice data, operator data, public utilities data, network tracing data	Personal identity information, public service information, traces of personal consumption, Internet user and behavior information	Huadao personal credit assessment, consumer credit information sharing platform CISP, credit service cloud platform	Startup with data resources

Source: Organized from public information.

From the perspective of the industry, Sesame Credit Management and Tencent Credit Investigation serve for Internet enterprises, Shenzhen Qianhai Credit Investigation Center for insurance enterprises and Peng Yuan Credit Investigation, China Chengxin Credit and Zhicheng for credit investigation enterprises, while Koala Credit Investigation and Beijing Huadao Credit Investigation are essentially newcomers with data resources.

The nature of the enterprise determines its business model. The differences in industries and business characteristics of the eight credit investigation enterprises lead to the different data sources for credit investigation. The data of Sesame Credit comes from the online transaction data of "Ali-affiliated" e-commerce, enterprises with equity participation and Alipay (credit card repayment, utility payment, and personal transaction, etc.) (JU Chuanxiao, 2018; Xiao Kaiwen, 2019; ZHANG Yun, XIAO Yu & ZHU Nan, 2016). Tencent Credit Investigation can easily access users' social data on WeChat and QQ and Tenpay's financial data. Qianhai Credit Information Center has Ping An Group's online data, financial data provided by over 50 partnered financial companies, and location and speech data from the Ping An Group's mobile APP, etc. Pengyuan Credit Information Co., Ltd is supported by government data. For China Chengxin Credit, its advantage comes from having over 100 small and medium-sized banks in China (it started to help banks build credit risk control models since 2003). Koala Credit is competitive in owning over 400,000 offline convenience stores. Eight enterprises carry out separate credit investigation business based on different data sources.

Although having different data sources, the eight credit investigation enterprises have similar data dimensions in personal credit assessment. Companies, in order to improve the accuracy of the credit investigation results, will try to obtain the assessment data from various sources. Except Sesame Credit focuses more on the application scenarios in daily life, while the application scenarios of the other credit investigation enterprises are more inclined to financial scenarios.

The eight companies have different backgrounds and data processing methods. The Internet enterprises, led by Sesame Credit, are born in the information era and have promoted data processing technology to maximize the practical significance behind the credit investigation data. On the contrary, traditional financial enterprises with credit investigation businesses are accustomed to using structured data and cannot respond well to changes in the data structure. Most traditional financial companies are still using big data analysis for personal credit investigations on the Internet.

As the Internet has become an important source of personal credit information, eight personal credit investigation enterprises are involved in the Internet credit investigation business. Sesame Credit and Tencent Credit Investigation rely on the massive user data of their parent companies and use the Internet as the main data source for credit investigation services.

Baihang Credit Information Co., Ltd.

Although the above eight individual credit reporting companies launched innovative application products during implementing the credit information preparation work, the enterprises still independently operate their credit information systems. The presence of credit data barriers has hindered the exchange of personal credit information between enterprises. Each enterprise regards its own superior data source as the main dimension of the personal credit evaluation model. Thus, the deviation between the credit evaluation results of different enterprises has halted the formation of an Internet credit information market.

Baihang Credit Information Co., Ltd. was established in March 2018 under the supervision of the People's Bank of China. It is administrated by China Internet Finance Association and Sesame Credit, Tencent Credit, Qianhai Credit, Pengyuan Credit, China Credit, and Zhongzhi. Based on the principles of "joint business construction, mutual benefit, and win-win cooperation", the eight companies jointly established the first market-oriented personal credit reporting agency with a registered capital of 1 billion yuan. As the only licensed market-based personal credit reporting agency, Baihang Credit Information Co., Ltd. is managed by China Internet Finance Association and the eight enterprises mentioned above. By aggregating eight companies' business advantages, Baihang Credit Information Co., Ltd. supplements the traditional People's Bank of China and contributes to a more comprehensive and effective market-oriented personal credit information system. The establishment of Baihang Credit Information Co., Ltd. shattered the information barriers between the eight enterprises, which is beneficial to the data sharing between enterprises. However, the amount of Internet credit data and its complex data structures pose challenges for data sharing. Users may present different behavior patterns in different platforms. Resolving problems brought by these differences is an urgency for data integration companies.

As of October 2019, the number of banking institutions that have granted credit to Baihang Credit Information Co., Ltd. has exceeded 1,200. 750 of which have signed information-sharing agreements with Baihang Credit Information Co., Ltd. and 500 have developed API interfaces and obtained system access. The personal credit information system of Baihang Credit Information Co., Ltd. has recorded 100 million natural person information subjects, and the number of credit accounts exceeded 120 million. Baihang Credit Information Co., Ltd. has launched three personal products, special attention list and information verification and verification products. The cumulative number of credit reports exceeded 30 million with an average daily inquiry of 400,000, and the peak number of inquiries in a day reached 900,000. The total number of inquiries for information verification products exceeded 13 million. According to its planning and development of the next three years, Baihang Credit Information Co., Ltd. is committed to creating a credit ecosystem that upholds mutually beneficial cooperations, enriches product content and broadens product designs and product promotions.

As China's only licensed market-based personal credit reporting agency, Baihang Credit Information Co., Ltd. will continue to adhere to the concept of "joint business construction, mutual benefit, and win-win cooperation" and work with other financial institutions and industries. It aims to strengthen partnerships to build a credit ecosystem and make even greater contributions to the healthy development of China's credit information industry.

USERS OF INTERNET PERSONAL CREDIT INFORMATION

The main users of personal credit information in China are credit departments. Besides banks, licensed credit institutions and Internet financial institutions, the traditional credit information application scenarios also include public utilities and other public sectors. In the Internet era, the application of credit information also includes some life scenarios.

Based on the personal credit information of the borrower, the financial institution analyzes the borrower's credit level and default risk with the help of a credit model, and makes specific decisions on whether to grant the loan, the specific terms of the loan, and whether mortgages are required. The public utility sector possesses the personal non-financial debt data and is the main provider and user of personal credit data. Public agencies such as social security units, courts, and industrial and commercial bureaus are also users of personal credit information. Taking the court as an example, under certain circumstances, the court may query the individual credit report of the subject involved without obtaining their consent and use it as the basis for the case's decision.

The development of the personal credit investigation industry and the wide application of big data and cloud computing technology have further expanded the application scenarios of personal credit investigation data. Sesame Credit scores individual credit status from five dimensions: credit history, behaviors, identity, commitment level and interpersonal relationships. Sesame Credit covers rent, travel, accommodation, communication, finance, etc. Life service providers and financial institutions can refer to users' Sesame points to provide corresponding deposit relief, procedures simplification and other services.

The credit finance scenario in banks and other licensed institutions and the credit life scenario represented by innovative application scenarios apply for personal credit data. Table 2 summarizes the main scenarios of the use of personal credit data in

the Internet personal credit business.

Table 2: Application Scenarios of Personal Credit Information

Scenario	Instance	Classification
Bank	Commercial Banks, rural credit cooperatives, etc.	Credit in finance
Other licensed credit institutions	Consumer finance, small loans, guarantee, financial leasing, etc.	Credit in finance
Internet financial institutions	Internet banking, Internet consumer finance, P2P lending, Internet small loans	Credit in finance
Public utilities	Telecommunications, power grids, etc.	Credit in life
Public sector	Social security, industry and commerce, taxation, court, public accumulation fund	Credit in life
Innovative application scenarios	Free of charge, post-payment, privileges, sharing economy application enterprises	Credit in life

Source: Organized from public information.

It is worth noting that innovative scenarios have made people's daily life more convenient while creating profits for enterprises. Taking the deposit-free bicycle sharing service as an example, the multi-dimensional credit data of the residents is collected by the credit reporting company, depicting a complete user portrait and reflecting the overall credit level of the user. Residents with a high level of credit will enjoy the bicycle sharing service without paying the deposit. At the end of the ride, they only need to pay the rent of the bicycle. The deposit-free feature gained an easier entry for bicycle sharing service into daily life, allowing bicycle service providers to explore the user market. Also, as the deposit-free service is based on the results of credit evaluation, the person who uses this service must be a resident who has a good performance in the credit evaluation, a high credit rating and low risk of default. Customers selected based on the above models are of high quality, and the risks faced by service providers are relatively controllable. As seen from the example, the deposit-free service is beneficial to both users and service providers, that's why this business model has been widely accepted by the market.

PROBLEMS IN THE APPLICATION OF INTERNET PERSONAL CREDIT INVESTIGATION

Social Problems Of Credit Data Collection

First is insufficient privacy and data security protection. As credit assessment is increasingly involved in personal life, more personal data and information will be collected. However, Internet credit investigation is still in its infancy with inadequate supervision. Measures have to be taken to ensure the privacy and safety of users in the Internet credit investigation industry (XIANG Liling & CHEN Xiulan, 2019).

Second, the openness of the Internet challenges the protection of credit enterprises and user data. Take Sesame Credit as an example, its data source is mainly from user transaction data of "Ali department" enterprises and platforms, containing bank card number, ID number, mobile phone number and other sensitive information. Besides its own data, Sesame Credit also accesses data from a third party. Mutual benefits aside, Sesame Credit must take measures to ensure the safety of this part of data in transmission and use (M Ke, S Chen, N Cai & L Zhang, 2018).

The third is the insufficient credit coverage of enterprises' credit information. Without a uniform model, the validity of the credit information is in doubt. Sesame Credit relies on user transaction data for personal credit evaluation; while Tencent uses individual social data, Tenpay financial review, and data from credit reporting companies to design the credit evaluation standard. Little information exchange between channels leads to biased evaluation results. Thus, the evaluation standard for showing the user's real credit level is questionable.

Still, unreliable credit data may be used for credit evaluation. In order to improve the credibility of credit score, some Internet personal credit investigation enterprises led by Sesame Credit have published their credit evaluation dimensions and their respective proportions. However, the virtuality of the Internet makes the reliability of credit investigation data hard to achieve. Individuals may deliberately beautify their credit data to get better services, resulting in inaccurate credit score results.

Credit Data Processing Capacity Needs Improvement

Lack of a universal evaluation model in the credit evaluation market is troublesome. Although different Internet personal credit enterprises have similar credit evaluation dimensions, the dimensions are varied proportionally. Credit reporting companies rely on their competitive strengths to provide credit reporting services, leading to different individual credit evaluation results. The lack of a universal Internet personal credit evaluation model in the market will be detrimental to the effectiveness of the personal credit market.

Also, the analysis technique employed by non-Internet enterprises for massive unstructured credit data needs to be improved. Traditional financial credit investigation businesses mostly rely on structured financial data, which requires less processing capacity. However, the complexity of Internet data requires more advanced data processing technology of credit investigation enterprises. The non-Internet companies headed by Qianhai Credit Co., Ltd. have not fully adapted to the characteristics of the Internet data, and the data processing technology is mainly based on big data analysis. It is inevitable to deal with complicated and unstructured data from the Internet when conducting credit reporting. Non-Internet credit reporting companies need to fully comprehend the characteristics of the data and improve their own unstructured data analysis technology to respond to changes in their data sources.

The Significance Of Improving The Use Of Credit Data

The second presentation of credit data makes it difficult for users of credit information to know the true credit status of the credited person (Xie Li & Yao Shikun, 2018). Internet credit investigation enterprises integrate various information of users and establish credit portraits of users, most of which are presented in credit scores. In personal credit investigation, the overall credit status is judged from credit scores. The raw data shall be reported to the central database by various institutions, and the credit investigation institutions shall conduct secondary processing and presentation of the data. The user of credit information cannot directly read the raw data as the information obtained from the credit report is limited and it is impossible to know the details of each business.

Insufficient development of life service application scenarios. In the Internet personal credit industry, the data application scenarios have expanded from credit finance to credit life, bringing more convenience to creditors. Credit information derives from life and should serve life. Internet credit reporting companies have made great attempts in the application of sesame credit in terms of life applications. However, other enterprises are more inclined to provide services for the financial market and refuse to explore possibilities in life application scenarios.

SUGGESTIONS ON THE DEVELOPMENT OF INTERNET PERSONAL CREDIT INVESTIGATION APPLICATION

Strengthen The Construction Of Information Security System

Users in the Internet era pay more attention to personal privacy. As sensitive data, credit information must be given enough attention and protection. Besides building an information security system to defend against external attacks, Internet personal credit reporting companies should also strengthen the privacy protection of internal systems and avoid using creditors' information for other purposes without approval.

Strengthen Government Supervision And Law Construction

Regulatory policy lags are common in emerging industries and markets. The data barriers and data authenticity problems in China's Internet personal credit information market are mainly due to regulatory and legal lags. To improve the efficiency of the credit information market, we must strengthen government supervision, improve industrial policies, and introduce laws and regulations on personal privacy protection, credit data sharing, and credit data verification.

Improve The Personal Credit Evaluation System

Improving the credit evaluation system is essential in ensuring the validity of credit evaluation results. The key to improving the effectiveness of Internet personal credit reporting results is to establish a universal credit evaluation model. Individual credit information enterprises should expand their data sources, strengthen data sharing among enterprises, enhance the underlying information mining capabilities of data, and strive to establish a universal personal credit evaluation model that is more responsive to users' true credit levels.

Improve Data Processing Technology

Faced with complex data clusters and data structures in the age of the Internet, data users must improve their adaptability. Internet credit reporting companies must give full play to their data analysis capabilities while non-Internet credit reporting companies should focus more on data analysis techniques and data verification capabilities. Artificial intelligence, machine learning, blockchain and other technologies can further enhance data processing technology and data foundation information mining of Internet personal credit information enterprises. Also, the cross-validation of data should be taken seriously.

Boost Credit Data Sharing

The secondary presentation of credit data is beneficial to the efficiency of credit data. However, in some application scenarios, relying solely on integrated credit data may lead to inaccuracy. Certain application scenarios may be more inclined to a certain credit dimension of the creditor. Thus, companies should establish a credit data sharing mechanism. Under the premise of user authorization, the credit information enterprise can provide the user's desensitization data level interface while providing the user's comprehensive credit score to the credit sub-use main body to reduce the information asymmetry between the credit information holder and the user. More multi-dimensional data helps to portrait the user while verifying the authenticity of the data, providing users with comprehensive and reliable credit evaluation data.

Expand The Application Scenarios Of Credit Investigation Data In Life Services

The development of the personal credit investigation industry has expanded the application of credit data from credit finance to

credit life. Credit information originates from life and should also serve life. Internet credit investigation enterprises should take the initiative to explore more life application scenarios of credit investigation services and provide more convenience for credit holders.

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Artificial Intelligence and Business Management: A Scientometric Analysis using CiteSpace (Full Paper)

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ABSTRACT

The interactions between artificial intelligence and business management have been one of the most critical and dynamic research areas in the field of business in recent years. This paper reviews related literature of artificial intelligence and business management, and studies the evolution of emerging trends by using CiteSpace to evaluate all relevant academic publications. The cluster, timezone and timeline visualizations have identified emerging trends of artificial intelligence and business management with three key topics: cost justification, big data, and decision-making. Cost justification is the hottest one in early years, followed by big data. In the last several years, decision-making is hot for artificial intelligence and business management.

Keywords: Artificial intelligence; Business management; Scientometric analysis; CiteSpace

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INTRODUCTION

With the arrival of the “Age of Big Data”, artificial intelligence has been an increasing concern (Gandomi and Haider, 2015; Aradau and Blanke, 2017; Secundo et al., 2017). It involves the activities of specification, capture, storage, access, distribution, management, and analysis of large complex datasets, in order to gain insight into its content and exert its value in decision-making (Partridge and Hussain, 1992; Liebowitz, 2001; Dremel et al., 2015). The datasets often consist of massive volumes of heterogeneous data in unstructured text, audio, and video formats (Ernst and Ojha, 1986; Wu et al., 2014; Hashem, 2015). As an important application field for artificial intelligence, business management have greatly improved (Li, 1994; Kolbjørnsrud et al., 2016; Brynjolfsson, 2017). The interactions between artificial intelligence and business management have been extremely complex as time goes on (Xu et al., 2002; Wright and Schultz, 2018). The emerging trends of artificial intelligence and business management need to be grasped for the development of the both.

Scientific publications in the artificial intelligence and business management have increased dramatically over the past decades (Herschel and Jones, 2005; Klumpp, 2018). At the same time, owing to technology and methodology advances, the diversity of topics within business research has also increased (McDougall et al., 1994; Jourdan et al., 2008; Meyer and Peng, 2016). In the field of scientometrics, researchers have been using data of scientific publications to analyze the patterns and trends of scientific collaboration for a long time (Chen, 2006; Chen, 2017). However, scientometric studies of the artificial intelligence and business management still remain limited. Therefore, in order to discover and develop the trends to achieve the integrity and universality of these technologies and contribute to the related research in the artificial intelligence and business management, a scientometric analysis using CiteSpace is conducted to explore the artificial intelligence and business management emerging trends from the perspective of data-driven and accelerate the development of this area, which may generate new research ideas and offer a great reference for scholars.

This paper aims to excavate the trends of artificial intelligence and business management based on a scientometric analysis using CiteSpace. The remainder of this study is constructed as follows. Basic analysis for related academic publications is conducted in Section 2. In Section 3, the results by using CiteSpace to demonstrate artificial intelligence and business management emerging trends are provided. Finally, conclusions are presented in Section 4.

BASIC ANALYSIS

To accurately summarize relevant studies from researchers, Web of Science Core Collection database is used to search for existing articles.

By using Boolean Logic technology and the search string “TS=(artificial Intelligence) AND TS=(business management)”, 359 related articles were found with the time slice ranging from 1990 to 2018 (publications till the end of 2018). Firstly, the research trend of artificial intelligence and business management by year is analyzed based on these articles, as shown in Fig. 1. It can be seen that artificial intelligence and business management related articles are few before 2008, and then increase, reaching a peak in recent years.

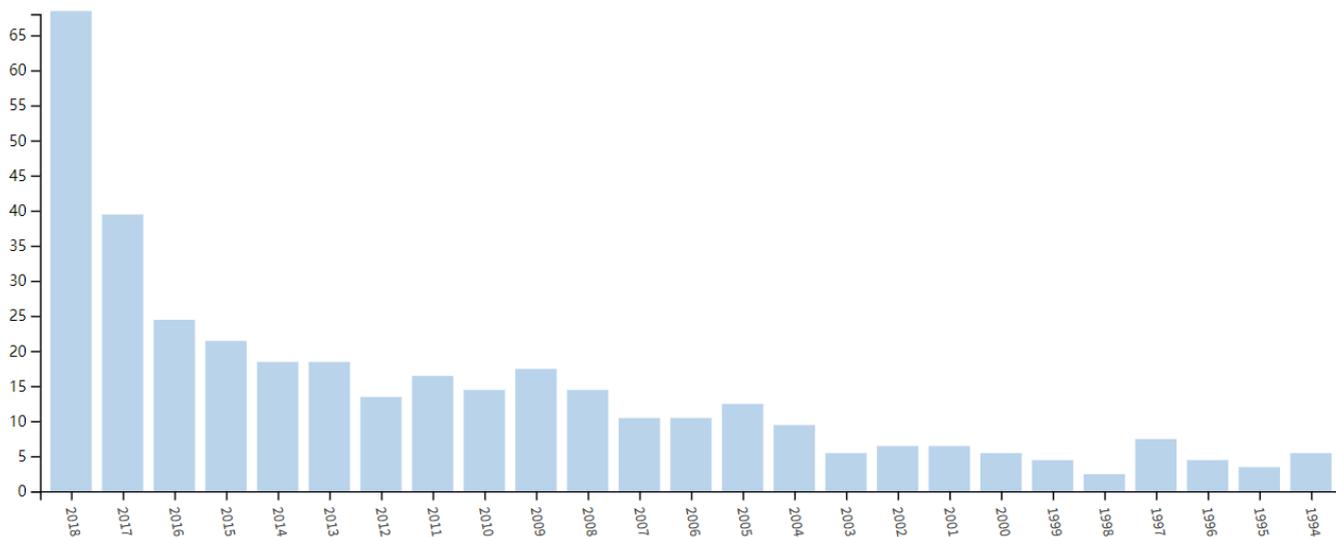


Figure 1: Publication number of artificial intelligence and business management related articles by year.

Fig. 2 demonstrates related results based on research fields. From this figure, computer science, engineering, and business economics are the fields with the most related publications. In addition, operations research management science has a relatively high number of relevant papers.



Figure 2: Research fields of artificial intelligence and business management related articles.

Then the artificial intelligence and business management related articles are analyzed by countries as shown in Fig. 3. It can be seen that the country which most studied artificial intelligence and business management is the United States, accounting for nearly 19% of the total related articles, followed by China with a proportion of over 12%. The third is England, which occupies just below 7% of the total. The academic publications related to artificial intelligence and business management of these three countries make up nearly 38% of the total. Besides, there are some other countries with articles focusing on artificial intelligence and business management, such as Germany, India, Italy, Romania, Australia, France and Spain.

Field: Countries/Regions	Record Count	% of 359
USA	68	18.942 %
PEOPLES R CHINA	44	12.256 %
ENGLAND	24	6.685 %
GERMANY	22	6.128 %
INDIA	17	4.735 %
ITALY	17	4.735 %
ROMANIA	17	4.735 %
AUSTRALIA	16	4.457 %
FRANCE	16	4.457 %
SPAIN	15	4.178 %
NETHERLANDS	11	3.064 %
CZECH REPUBLIC	10	2.786 %
RUSSIA	10	2.786 %

Figure 3: Countries of artificial intelligence and business management related articles.

ARTIFICIAL INTELLIGENCE AND BUSINESS MANAGEMENT EMERGING TRENDS

In this section, the emerging trends of artificial intelligence and business management are explored based on Citespace.

CiteSpace is a free Java application for visualizing and analyzing citations and contents in scientific literature (Chen et al., 2012; Wei et al., 2015). It can be applied to the analysis of multiple, time-sharing, and dynamic complex networks, and to detect the hotspots and evolution in a certain field (Cui et al., 2018). Based on the 359 related articles with the time slice ranging from 1990 to 2018, CiteSpace is used to analyze artificial intelligence and business management emerging trends. As a type of co-occurrence analysis, keyword-based analysis has played an important role in understanding knowledge development dynamics. For visualization, different network analysis views; cluster, timeline, and timezone; were available, from which the patterns and trends in artificial intelligence and business management literature were revealed.

Science mapping is a strong literature measurement technology for studying the conceptual structure of the specific research field, because it allows for the monitoring and delineation of research areas in the field of science to determine structure and evolution (Cobo et al., 2011). It is based on the knowledge of the field and it describes the progress and framework, reveals the complicated relationship between singles and groups of knowledge (Healey et al., 1986). CiteSpace can identify spectral features. In the early days, science did not have a unified paradigm. In the medium term, a paradigm is needed to develop science, and finding this paradigm is a scientific revolution (Lahneman, 2012; Wion et al, 2015). Therefore, using CiteSpace to build knowledge mapping, reveal cutting-edge research, and find the evolution of knowledge.

CiteSpace's cluster recognition trajectory is used to simulate the development trends of artificial intelligence and business management. Because CiteSpace recognizes co-citation clustering in the literature index to track research trends, most CiteSpace software is a technique for selecting algorithms through spectral clustering and features, allowing visualization of results to understand trends and evolution. Its timeline view allows visualization and identification of the artificial intelligence and business management trends of the publication year. A visualization of the search results to make sense of the trends and evolutions is the main characteristic of CiteSpace, with the CiteSpace cluster analyses revealing the relationships between the keywords from artificial intelligence and business management related articles. The 'Cluster View' graph is shown in Fig. 4.

The modularity and mean silhouette scores are the two important metrics used to describe the overall structural network properties. In general, the modularity values in Fig. 4 (0.9293) were relatively high, which indicated that the network's loosely coupled clusters were reasonably divided. The silhouette measure is used to determine whether the data is appropriately clustered; when the silhouette measure is close to one, the data is appropriately clustered and when it is close to minus one, the

data is not appropriately clustered. However, when the silhouette measure is near zero, the data is on the border of these two natural clusters. The mean silhouette scores suggested that on average, the cluster homogeneity of artificial intelligence and business management trends (0.4105) was relatively high.

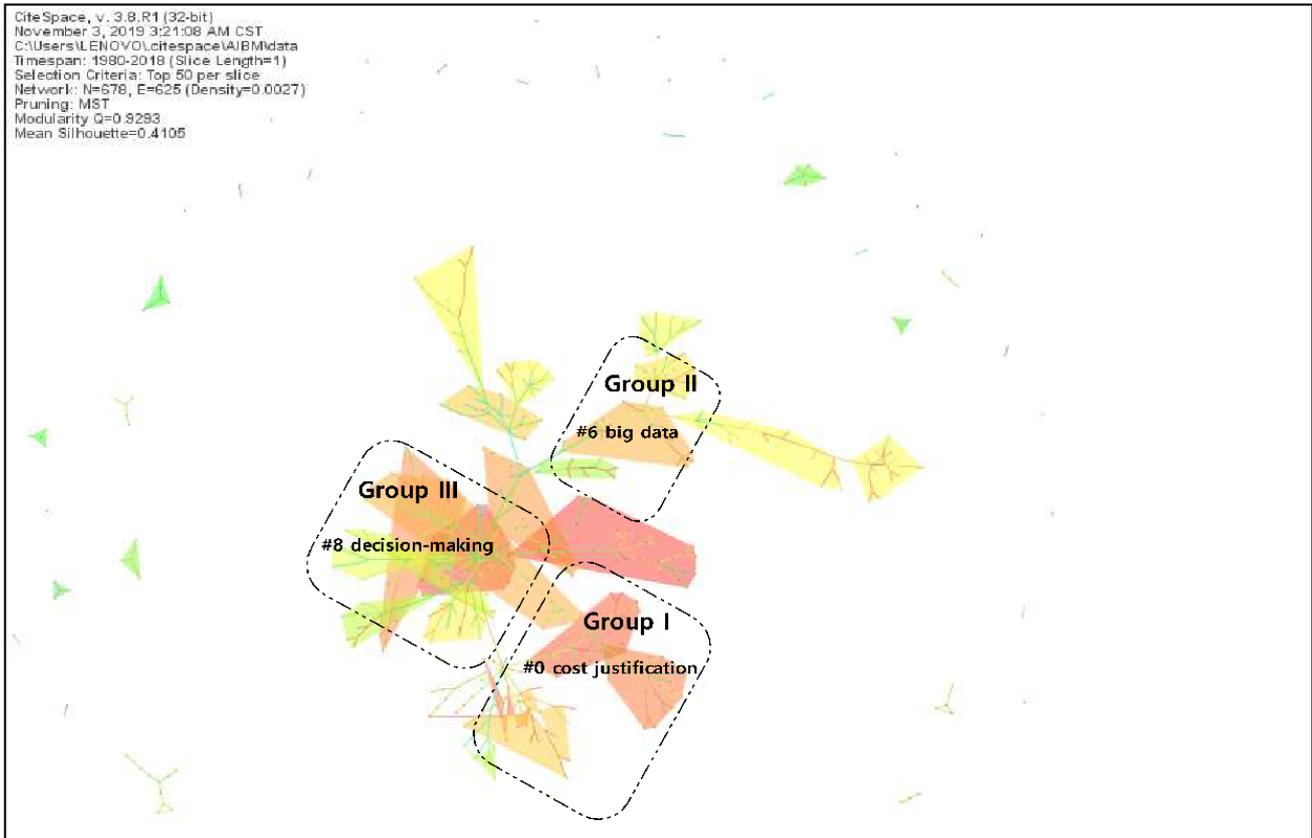


Figure 4: Keywords co-occurrence and cluster view of related studies for artificial intelligence and business management.

To determine the most appropriate clusters, silhouette and size measures were used. Three clusters with the cluster label (LLR); “cost justification”, “big data” and “decision-making”; were extracted as they had high silhouettes (ID: 0, 6, 8; silhouette: 0.658, 0.552, 0.704) and were a relatively large size (38, 29, 27). The mean years of these three topics are 2003, 2008, and 2012, respectively. As the keywords in the above three clusters were distinct, it was decided that these were representative of the different artificial intelligence and business management trends. All three clusters and the associated keywords were gathered into three groups, as shown in Fig. 4.

Changing the layout to ‘Timeline View’ and ‘Timezone View’ in Figs. 5 and 6, the clusters vary with time (year), with the distribution of the three groups each occurring in different time periods; “cost justification”, followed by “big data” and then “decision-making”, clearly indicating the artificial intelligence and business management evolution. Therefore, from the above analysis, three clear artificial intelligence and business management stages were revealed.

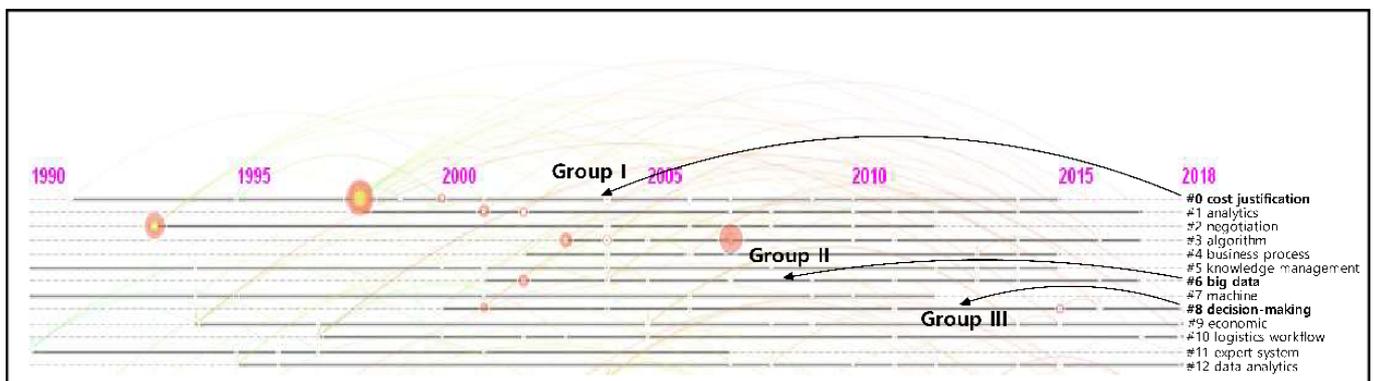


Figure 5: Clusters with timeline view of related studies for artificial intelligence and business management.

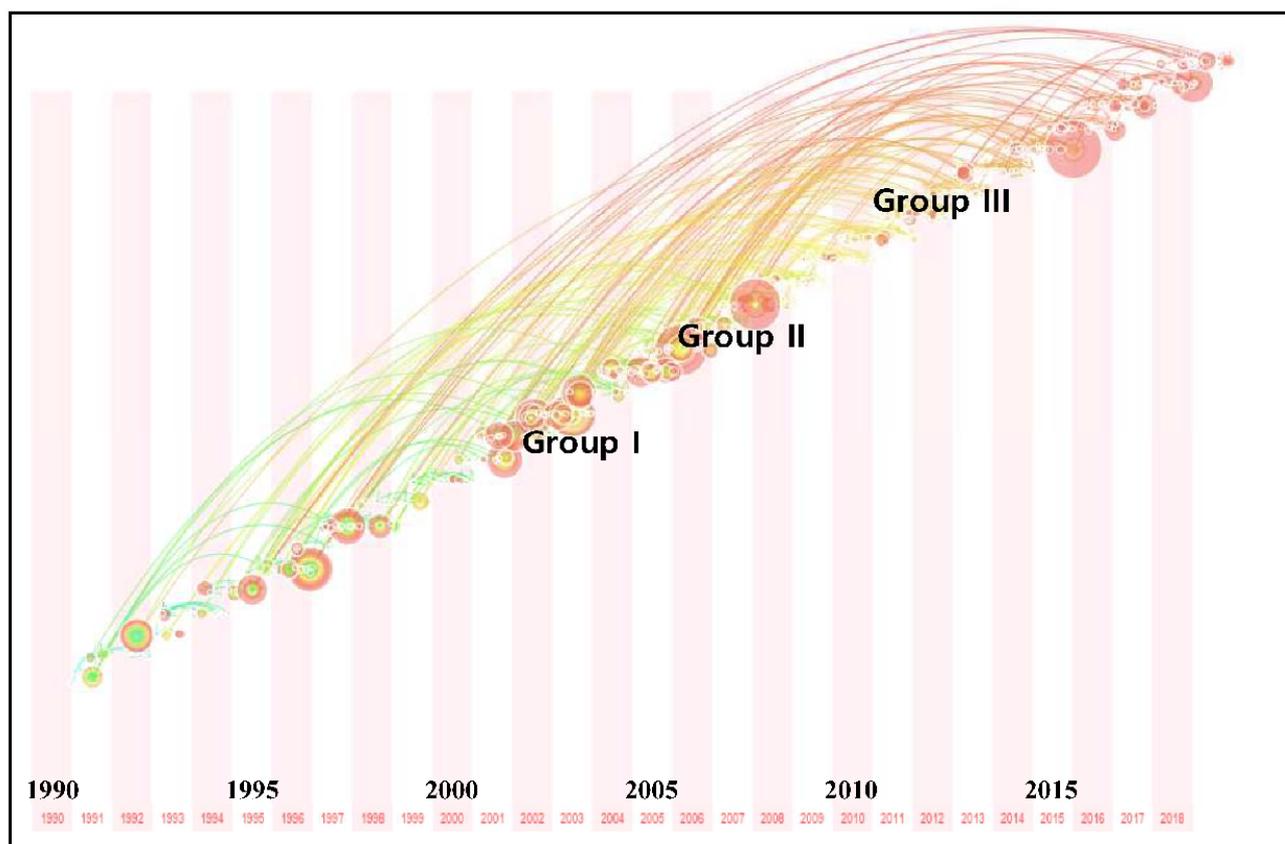


Figure 6: Clusters with timezone view of related studies for artificial intelligence and business management.

Scientific mapping with cluster and visualization was inspired by Kuhn's scientific paradigm notion, which provided a framework for matching visual-spatial patterns to the movements of an underlying paradigm. In Dosi's model, the sense of "trajectory" was aligned with "normal science", as technological activities guided by a specific paradigm naturally form a "technological trajectory". In other words, technological trajectories can be found in the clusters analyzed using the CiteSpace, with the turning points being the research papers that connect the different clusters. From the visual knowledge map (i.e., Fig 4), there were three distinct clusters; "cost justification", "big data" and "decision-making"; which could be further analyzed for artificial intelligence and business management trends. By combining the three life cycle stages of the paradigm theory and the above three cluster classifications, artificial intelligence and business management trends were identified, as shown in Fig. 6. Cost justification is the initial phase of the artificial intelligence applied into the business management, which focused on the cost when conducting operation activities. Big data is hot with the arrival of the "Age of Big Data", which gave rise to data-driven business management. The most current keyword, decision-making, reflects the business management being back to itself (including logistics, operational risk, finance, and so on) in recent years.

CONCLUSIONS

In this paper, a scientometric analysis using CiteSpace is applied to elucidate the current and future artificial intelligence and business management trends. Using appropriate technology and software, this scientometric analysis was developed with data collection and visualization to determine the relevant research foci. Using the scientometric analysis, keyword focus trends were identified to assess the three distinct artificial intelligence and business management stages. The scientometric analysis gives a view of the current foci and trends of artificial intelligence and business management. From the exploration trajectory in this paper, the technologies preceding the "shift stage" acted as the developmental foundation.

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APPENDIX

The details of CiteSpace are introduced here. Fig. A1 shows the system of CiteSpace. It can be seen that there are two important links for this system: Project Home and Data Directory. Generally, the files downloaded (i.e., Data Directory) from

Web of Science Core Collection database should be stored in Disk C, such as C:\Users\LENOVO\.citespace\AIBM\data. Meanwhile, the results (i.e., Project Home) based on CiteSpace should be stored in the same folder of Disk C, such as C:\Users\LENOVO\.citespace\AIBM\project. To run a new project in CiteSpace, we should click the “New” button to select proper dataset and results storage links, as shown in Fig. A2. At the same time, the language can be chosen based on the database. For example, Chinese can be selected when the database are from Chinese National Knowledge Infrastructure (CNKI). After making a new project, the time slicing can be set: the time range and the years per slice. For the text processing, term sources (title, abstract, author keywords, and keywords plus) can be chosen, and term types (noun phrases and burst terms) can be adopted. For the network configuration, there are various node types can be chosen: author, institution, country, term, keyword, category, cited reference, cited author, cited journal, paper and grant. The keyword is usually taken to analyze the research trends of a specific research field. The options for Cosine, Dice and Jaccard coefficients can be adopted as link strengths, while the options of within slice and across slice are selectable as link scopes for users. The options for top N per slice, top N% per slice, threshold interpolation, and select citers can be chosen as node selection criteria. For the top N per slice, top 50 most cited or occurred items from each slice is the default. For the top N% per slice, top 1% most cited or occurred items from each slice is the default. In the pruning options, pathfinder, and minimum spanning tree can be adopted as pruning tools, while pruning sliced networks and pruning the merged network can be taken as pruning detailed methods. In the visualization options, static and animated modes can be chosen as cluster views. Meanwhile, networks by time slice and merged network can be adopted as presentation modes in CiteSpace. When these options are set, the “GO!” can be clicked to run this new project. About several minutes later, the basic results can be generated. As we can see from Fig. A1, the 359 related articles have been pruned into 325 records. Then we can choose visualization modes for further analysis.

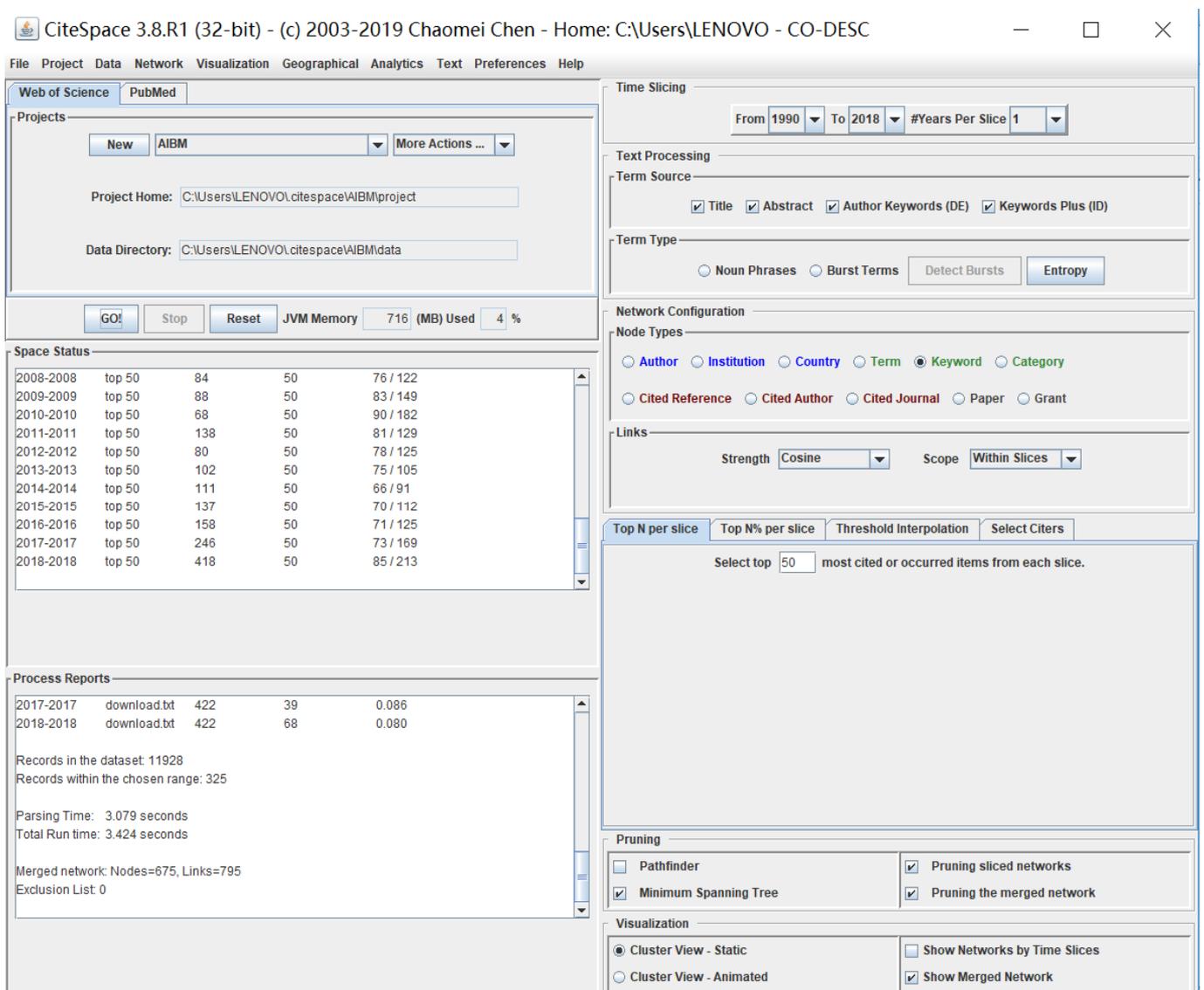


Figure A1: The system of CiteSpace.

Figure A2: The new project window in CiteSpace.

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Assessing a Business Software Application using Strategic IT Alignment Factors: A New Way for IS Evaluation?

(Full Paper)

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ABSTRACT

The alignment between the business strategy of an organization and its related information technology (IT) strategy, infrastructure and processes remains important for both research and practice. Prior studies have shown that effective strategic IT alignment (SITA) leads to effective business value. When measuring the SITA, these studies focused on the overall information system (IS) of an organization. However, it would be useful for practitioners to evaluate, not only a global alignment, but also the alignment of a specific business software application, which could lead to business value as well. Previous investigations in the IS evaluation field, such as studies related to the Information Systems Success Model (ISSM), do not include strategic alignment factors. In this contribution, we address the issue of how to evaluate a business software application using SITA factors. To identify SITA factors, we selected a set of scientific papers and documents from practitioners related to strategic alignment and we used them as input for a coding process. We followed the thematic analysis method for coding and we obtained a hierarchical structure of SITA factors. From this structure, and based on the Strategic Alignment Model (SAM), we built an emergent alignment model that clarifies relations between a business software application and first the organization's strategies (business and IT), second the organizational structure, and third the processes and operations of the IT department. The model reveals that all relations, except those between business strategy, organizational structure and business operations, are appropriate for evaluating the strategic alignment of a business software application.

Keywords: strategic alignment, information system, IT strategy, IS evaluation, business application, strategic alignment model

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INTRODUCTION

The literature suggests that organizations must have their business and information technology (IT) strategies aligned if they want to be competitive. A meta-analysis of previous studies in strategic IT alignment (SITA) reports a positive impact of SITA on firm performance (Gerow et al., 2014). More recently, this impact has been confirmed, especially when the alignment is considered as a state of congruence (Sabherwal et al., 2019). The importance of SITA has been reported many times as highlighted in a bibliometric study (Renaud, Walsh, & Kalika, 2016).

Through the years, organizations have built up an enormous number of software applications in their portfolio, but they do not need all of them (Riempp & Gieffers-Ankel, 2007). Moreover, a significant proportion of IT budgets is simply used to keep the current application portfolio running in organizations (Dedrick, Gurbaxani, & Kraemer, 2003). Considering these aspects and the accelerating digital transformation which together increase business change needs, IT managers need more than ever to take decisions on their existing applications: keeping or killing each of them.

The research field of information system (IS) evaluation provides different ways to evaluate an IS (DeLone & McLean, 2016; Smithson & Hirschheim, 1998). In practice, an IS evaluation could lead to a decision about keeping or discontinuing it. Most iconic models in that field – such as the Information System Success Model (ISSM) (DeLone & McLean, 1992, 2003, 2016) or the Technology Acceptance Model (TAM) (Davis, 1989) – can be used to evaluate some aspects of a business software application (shortened to *business application* in this text). However, despite all the different aspects of evaluating an IS in that field, strategic alignment is something that is missing.

Taking into account, firstly, that information systems could contribute to a firm's performance (Chan et al., 1997) or could provide net benefit (DeLone & McLean, 2016) and, secondly, that a lack of business value provided by information systems is partly due to a lack of strategic alignment (Henderson & Venkatraman, 1993), we argue that IT managers should be able to evaluate the strategic alignment of each of their existing business applications. This evaluation could help managers identify which applications are likely to provide a high level of business value or benefit, and therefore be able to take decisions about keeping or discontinuing them. This process is likely to improve the firm's performance. However, in the field of strategic alignment, existing research actually focuses on the strategic alignment of the organization's overall information system and not on alignment of a specific business application. Hence IS is considered as a subsystem of the firm, as defined preliminarily by Boulding (1956). This focus on the overall subsystem is clearly noticeable in all contributions identified in a study

comparing strategic alignment models (El-Mekawy, Rusu, & Perjons, 2015) and in another study that identifies contributions that address strategic alignment in the field of IS evaluation (Michel & Cocula, 2014).

Although there is no strategic alignment study focusing on business application evaluation, and no IS evaluation study focusing on strategic alignment, the need to consider the link between organization's strategic objectives and IS evaluation has already been stated (Smithson & Hirschheim, 1998). In this contribution, we want to address the issue of assessing an IS through the strategic alignment focus, by using strategic alignment factors. We formulate the following research question: *How can we evaluate a business software application using strategic IT alignment factors?*

Smithson and Hirschheim (1998) stated that there are unquantifiable and hidden commercial advantages behind information systems. However, they also claimed that, in the future, it will no longer be acceptable for the benefits provided by an IS not to be quantifiable and well formalized. By proposing a way of evaluating a business application using SITA factors, we address this issue of quantifying and formalizing benefits or impacts provided by an IS.

In this study, we review the literature in the research fields of IS evaluation and strategic alignment, and we demonstrate the existing gap at the intersection of these two fields. We explain our theoretical framework, which reflects our expectations about how strategic alignment of a business software application should be conceptualized. Then we detail the methodology we employed firstly to select a panel of scientific papers and practitioners' public documents, secondly to code them using thematic analysis, and finally to bring out a strategic alignment model that will provide understanding of the strategic alignment of a business application. Then we present and discuss the obtained model. We argue why this model is likely to be generalized and subsequently to be used as a framework to evaluate this alignment. Finally, we point out some managerial implications and give directions for future research.

THEORITICAL BACKGROUND

Information system scope

The real underlying definition of IS is not exactly the same, whether we are in the IS evaluation research field or in that of strategic alignment. In the literature, IS can be defined as a subsystem of the an organization, which is situated between the control and the operational organization's subsystems (Boulding, 1956; Le Moigne, 1977). With this definition, IS is unique in the organization and may therefore include several business applications. Yet it is also defined as a system which collects, memorizes, transforms, and provides information through the use of information technologies and operating methods (Laudon & Laudon, 2013, p. 20). In this way, IS is not necessarily considered as a unique system existing in the organization. These authors explain that IS can be classified according to its scope of use: individual, organizational, inter-organizational, or extra-organizational (Reix et al., 2016, p. 5), while others suggest classifying IS evaluation in five levels: macro, industrial sector, firm, application, stakeholder (Smithson & Hirschheim, 1998). According to them, the *application* level is "the focus of most of the literature" (Smithson & Hirschheim, 1998, p. 161). In this study we consider two types of IS: one that is a subsystem of a firm (large scope) and one considered to be a software application (small scope).

What kind of IS scope do researchers refer to when they work in the strategic alignment and IS evaluation fields? We have rarely seen authors explicitly defining this scope in published contributions. However, we notice that, in most cases, there is an implicit scope, depending on the research field. By examining a meta-analysis of past research in strategic alignment (Gerow et al., 2014), we state that, in this field, IS is undoubtedly considered as a subsystem of the organization; one strategic alignment evaluation seems to always refer to one IT and one business strategy specific to one firm. Our statement may be confirmed by another study, a bibliometric analysis of literature on strategic alignment (Bennani, Beldi, & Baile, 2004). In this study, authors classified contributions by level of analysis and determined that 77% of them are focused on the firm level, 13% on the inter-organizational one, 6% for business units and 4% for groups and others. There are no criteria about a scope such as software application.

In the IS evaluation field, as in IS success studies (DeLone & McLean, 1992, 2003, 2016; Petter, DeLone, & McLean, 2013), IS is not restricted to the subsystem of a firm and is, in most cases, considered to be an application (Smithson & Hirschheim, 1998). Indeed, measurable factors of system quality dimension of the ISSM, such as usability, availability, reliability, adaptability, or response time (DeLone & McLean, 2003), are more designed to evaluate an application than an overall firm's IS. As a result, we state that the meaning of IS is different depending on the research field: it is usually a unique subsystem of the firm in strategic alignment, and mostly an application in IS evaluation.

IS evaluation

Evaluation is unavoidable and prolific and is the first or second most covered topic in the field of information systems (Michel & Cocula, 2014). It has been reported for many years that the need for IS evaluation is increasing (Smithson & Hirschheim, 1998). A lot of reasons for evaluating IS have already been given, as have a lot difficulties in evaluation (Smithson & Hirschheim, 1998). One of the given reasons to evaluate is to support a decision between maintaining or redeveloping an old or inherited system (Smithson & Hirschheim, 1998). Our contribution matches with this reason: by understanding the relations between business/IT strategies and a business application, we come one step nearer to new method of IS evaluation that should help managers deciding if a system should be maintained, based on the fact that the better the alignment, the better the firm's performance should be.

As reported by DeLone and McLean (2003, 2016), the most important previous studies in IS evaluation have shown that a greater quality of IS involves a higher intention to use it, a higher effective use and a higher user satisfaction, and this finally has impacts on the firm that are usually net benefits. The quality of IS could be decomposed into information, system and service quality (DeLone & McLean, 2003, 2016), or even into performance and effort expectancy, social influence and facilitating conditions if we consider the context of use of IS (Venkatesh et al., 2003).

The literature in IS evaluation does not seem to consider a factor of IS quality like the application's alignment with business and IT strategies. Petter, DeLone, and McLean (2013) reviewed the literature to search independent variables of IS success, and identified 43. None of them were directly related to strategic alignment. They do consider the variable *type of IS*, which classifies an IS between strategic IS and transactional IS. However, as reported by their study, the influence of the *type of IS* on a firm's net benefits appears to be sometimes consistent and sometimes not. We think that we should consider the strategic alignment of an IS instead of its type. In the light of this study (Petter et al., 2013), we postulate that strategic alignment factors have not really been included yet in IS evaluation models such as ISSM.

Strategic IT alignment

There is no universal definition of strategic IT alignment (SITA; also shortened to *strategic alignment* in this text). The concept of SITA is recognized as ambiguous (Maes et al., 2000). Different names that refer to strategic alignment are reported to be used: fit, congruence, harmony, integration, link, bridge (Cumps et al., 2009), consistency (Walsh, Renaud, & Kalika, 2013), and adjustment (Rebai, 2013). Reich and Benbasat (2000, p. 82) said that "although there has been much attention paid to alignment, no comprehensive model is commonly used".

Strategic alignment is considered as a process by some authors, and as a state of congruence by others (Walsh et al., 2013). More recently, Sabherwal et al. (2019) revealed that strategic alignment is both a state of congruence and a reflecting capability over IT investment.

Authors have different views about what exactly strategic alignment is. In many cases, strategic alignment is considered as an alignment between a firm's business and IT strategies (Bergeron & Raymond, 1995; Chan et al., 1997; Sabherwal et al., 2019). For instance, authors explain it as "how well the content of the realized business strategy matches the content of the realized IT strategy" (Wu, Straub, & Liang, 2015, p. 503). Nevertheless, earlier researchers have examined alignment between four business and IT components: business strategy, IT strategy, business infrastructure and processes, and IT infrastructure and processes (Henderson & Venkatraman, 1993). Hence, "strategic alignment refers to the fit between two or more of these components" (Gerow et al., 2014, p. 1160). Studies often deal with the fit of two components over the four mentioned. For instance, some authors focused specifically on the harmony between business and IT in terms of management, excluding strategies aspects (Chan & Reich, 2007; Luftman, 2000), but we think that we can't exclude any of the four components from the strategic alignment definition. The importance of each link between the four components differs from one context to another. For example, a recent study highlighted that government officials in the public sector think that it is strategic fit that enhances performance, while managers in the private sector think that performance comes from functional integration (Hung & Lin, 2018).

As the strategic alignment model (SAM) remains the most well-known and the most widely used model in the strategic alignment field (Gerow et al., 2014; Renaud et al., 2016), and considering that SAM has practical and conceptual value and that frameworks have been created to help managers determine, monitor, and achieve alignment (Avison et al., 2004), we have decided to define strategic alignment as the fit between the four components of the SAM. This means that we define strategic alignment as the state of congruence and as the two links of strategic fit – alignment between business strategy and business infrastructure and processes; and alignment between IT strategy and IT infrastructure and processes – and the two links of functional integration – alignment between business and IT strategies; and alignment between business and IT infrastructure and processes.

Why should companies align their IT with their business strategy? It is well recognized that strategic alignment is about measuring the effect on a firm's performance. Previous investigations have shown that alignment between business and IT strategies, as a state of congruence, has a positive impact on a firm's performance (Bergeron & Raymond, 1995; Chan et al., 1997; Sabherwal et al., 2019). Others have demonstrated that alignment between business and IT (functional integration) also affects a firm's performance positively too (Chan & Reich, 2007; Sledgianowski, Luftman, & Reilly, 2006). This is even true for the harmony between executive and information system management teams (Croteau, Bergeron, & Raymond, 2001). Strategic alignment is also the most important determinant for success of IT investments (Hu & Huang, 2006). The recent study of Sabherwal et al. (2019) also revealed that alignment between business and IT strategies reflects a capability to improve the positive effect of IT investments on a firm's performance, when the firm is in a dynamic, complex, or hostile environment, but reflects a rigidity that reduces the positive effect when it is in a stable or simple environment. There were some studies that brought a paradox with their inconsistent findings on the effect of alignment on business value. However, according to a meta-analysis of the literature on strategic alignment, "the existent evidence suggests there is not much of an alignment paradox, which suggests alignment should lead to higher levels of performance" (Gerow et al., 2014, p. 1178). Thus, we can confirm the real benefits of improving strategic alignment in firms. Furthermore, considering that alignment between strategies, and alignment between business and IT processes, are both positively impacted by IT Governance (De Haes & Van

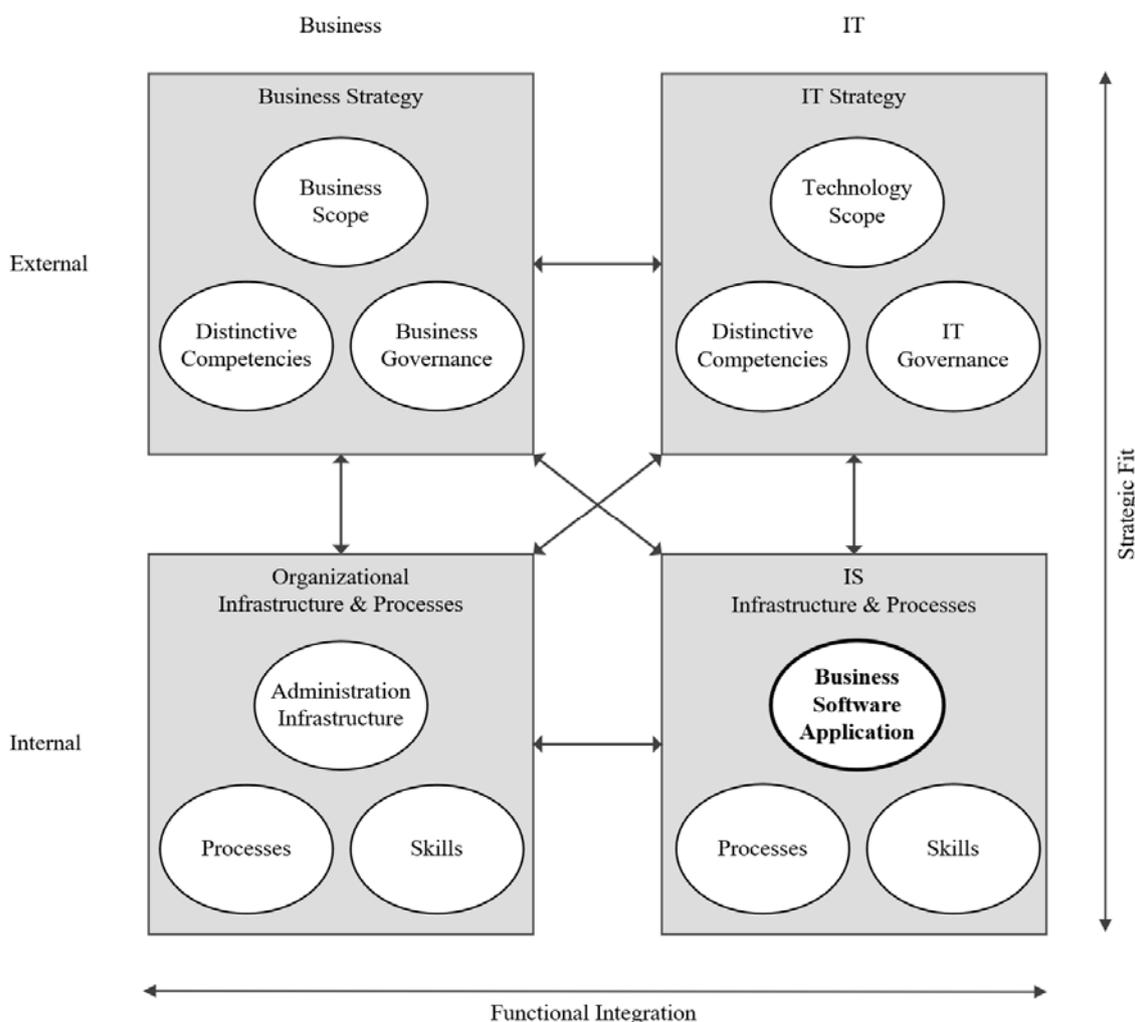
Grembergen, 2009; Wu et al., 2015), we also confirm the need to provide new knowledge and tools to managers in order to help them improve IT governance because that should consequently lead to better strategic alignment and then to better firm's performance.

Between IS evaluation and strategic alignment

As we have highlighted already, an information system is mostly considered as an application in the research field of IS evaluation and as an overall and unique subsystem of a firm in the field of strategic alignment. Consequently, strategic alignment models are not suitable for evaluating a specific business application. Furthermore, according to our literature review, there is no strategic alignment factor or concept that actually exists in IS evaluation models such as ISSM. Yet, in both fields, the targeted effect is a business value such as net benefit or more specifically firm's performance. It seems that no study has yet mixed these two fields, and this is what we aim to address with our contribution.

THEORITICAL FRAMEWORK

Given that, as we know, there are no existing alignment factors in IS evaluation models such as ISSM (Petter et al., 2013), we think that the best way to evaluate a strategic alignment of a business application is to take a strategic alignment model and then position the business application within it. To outline our research intention, we select the most widely used model, SAM (Henderson & Venkatraman, 1993), and adapt it by replacing *Architectures* located in the *IS Infrastructure & Processes* by *Business Software Application* (as represented in Figure 1). From this perspective, the *business software application* could be considered as a strategic information system, that was defined as an "information system used to support or shape an organization's competitive strategy" (Rackoff, Wiseman, & Ullrich, 1985, p. 285).



Source: Strategic Alignment Model (Henderson & Venkatraman, 1993) adapted for this study
 Figure 1: Theoretical framework

The theoretical framework presented here is not intended to be a final model able to reflect strategic alignment of a business application. Rather, it should help to give direction to our research. It suggests firstly that a business application should be located in the IS infrastructure and processes, meaning that a business application is something IT and internal to the firm. Secondly, as we put the business application in the place of IS architecture, we consider that this application is mainly a software issue. From this perspective, skills and processes located in IS infrastructure and processes domain are only

considered as human things (that is human skills and processes that require people). The business application could contain processes as well, but only embedded automated processes. Thirdly, the theoretical framework exhibits only one business application, whereas a lot of different business applications usually exist in a firm. This means that the model focuses only on one business application alignment. When more than one application is required to be evaluated, the model must be used several times, more precisely once for each application to be evaluated.

The presented theoretical framework does not detail relations between the business application and other specific components of the SAM, such as business administration or internal business processes. We are convinced that a brand-new model is necessary to more effectively address the issue of business application strategic alignment: a model that embraces, in detail, the links around the business application. The presented framework helps then to give an intention and a direction for designing a new and more detailed model.

METHODOLOGY

Creating a new theoretical model is about creating a new theory. Hence, we use the grounded theory principles (Glaser & Strauss, 1967) in order to code a selected qualitative data set and to obtain a hierarchical structure of alignments factors. From the resulting codes located at the top of the structure, we propose a new business application strategic alignment model. Coding qualitative data such as scientific papers has already been achieved in previous meta-analyses on strategic alignment and this usually gives meaningful outcomes (Gerow et al., 2014; Renaud et al., 2016).

Source of data

To code qualitative data, we selected a data set of articles and documents where each of them had addressed the subject of strategic alignment. We decided to select both scientific articles and public documents coming from practitioners. Although strategic alignment models elaborated by researchers appear to be theoretically justified, there is a lack of enthusiasm on the part of firms to adopt them, which demonstrates the existence of a gap between theory and practice in this area, as has already been highlighted (Renaud et al., 2016; Smithson & Hirschheim, 1998). Using this dual approach, we attempted to reflect, as well as possible, the entire picture of strategic alignment.

To select scientific articles, we chose tree studies that review the literature and show or compare a range of strategic alignment models (El-Mekawy et al., 2015; Michel & Cocula, 2014; Thevenet, 2009). Then we selected the references that authors mostly used in these tree studies. We gathered and prioritized all the selected references in one data set (Table 1). To allow the first important codes to be created, priority is given to the article of Henderson and Venkatraman (1993). Afterwards, priority is set using the average of citations per year, which is calculated from the number of citations given by Google Scholar and then divided by the number of years old of each article. This method introduced a bias for the article of Osterwalder et al. (2005), because the main subject of this article is not strategic alignment but business model and this article is well known in the business model research field. We corrected this bias by reducing its priority.

Table 1: Selected scientific articles for coding

Priority	Reference	Citations / year
1	Henderson and Venkatraman (1993)	181.6
5	Reich and Benbasat (2000)	85.8
2	Sabherwal and Chan (2001)	75.1
8	Chan et al. (1997)	70.2
3	Luftman (2000)	64.5
6	Maes et al. (2000)	13.4
7	Osterwalder et al. (2005)	212.3
9	Hu and Huang (2006)	7.9
4	Cumps et al. (2009)	4.6
10	Bergeron and Raymond (1995)	4.4
11	Walsh et al. (2013)	1.3
12	Bennani et al. (2004)	0.2

Source: This study

We did not proceed in the same way when selecting public documents coming from practitioners. To identify these documents, we used the public search engines of Google and retained websites that published documents for firms free of charge. The search allowed us to find relevant documents on the websites of the *Club informatique des grandes entreprises françaises* (Cigref), the *Information Systems Audit and Control Association* (ISACA) and the *Strategic ICT Institute*. Then we browsed each of these websites in depth in order to identify documents where strategic alignment is addressed and we finally retained five relevant documents for coding (Table 2).

Table 2: Selected public documents for coding

Priority	Authors	Document Title	Publisher	Retrieved from
1	Phelizon and	Alignement stratégique du système d'information:	Cigref	www.cigref.fr

	Rouhier (2002)	Comment faire du système d'information un atout pour l'entreprise?		
2	Phelizon (2007)	Baromètre Gouvernance Systèmes d'Information: Cadre d'évaluation d'une démarche de gouvernance du système d'information	Cigref	www.cigref.fr
3	Dhugga and Addison (2011)	Strategic ICT Toolkit for institutional self-analysis	StrategicICT	www.nottingham.ac.uk
4	AFAI (2006)	Maturité des entreprises en matière d'IT Governance	ISACA	www.isaca.org
5	Williams (2005)	IT Alignment: Who is in Charge?	ISACA	www.isaca.org

Source: This study

Coding

We used the selected articles and documents as qualitative data to code. We started by coding scientific articles and ended with public documents that come from practitioners. While we were coding, we endeavored to create codes that reflected potential strategic alignment factors. This process allowed us to form a hierarchical structure of strategic alignment factors.

The coding method used to develop a theory was first suggested by Glaser and Strauss (1967). Various different methods have since been proposed. To carry out our coding, we followed the thematic analysis method initially suggested by Boyatzis (1998) and more recently described by Paillé and Mucchielli (2012). Given that this method allows its user to extract a set of hierarchically structured themes (Boyatzis, 1998), it fully meets our needs. Thus, each theme corresponds to a potential strategic alignment factor.

Thematic analysis allows its user to answer the following question about a qualitative data set: *what is fundamental in this text and what exactly is it stating?* (Paillé & Mucchielli, 2012, p. 231). Before starting the thematic analysis, the users of this method have to make decisions about three issues (Paillé & Mucchielli, 2012): the nature of the material (paper or software), the location of written themes (in the margin of the document, within the text lines or on separate cards), and the type of approach (continuous or sequential). For our study, we chose the software NVivo 11.4.1, we wrote themes on separate cards and we opted for a continuous approach. The continuous approach means that new themes have to be identified for each new source processed, as opposed to the sequential approach which implies selecting only a sample of sources from the corpus to identify new themes and then only classifying into existing ones (Paillé & Mucchielli, 2012).

Before any thematic analysis, it is necessary to define the parameters of the study, as well as the researcher's stance (Paillé & Mucchielli, 2012). Parameters of the study provide guidance during identification of themes. The most important parameter is to define an objective to be achieved during the analysis. For our case, we fixed this objective by formulating the question: *what factors can influence strategic alignment in this text?* The researcher's stance is the mindset that the analyst must choose to carry out the retrieval of themes. For this study, we adopted the following stance: *be attentive to the elements that can be measured*. This was intended to extract strategic alignment factors that could be evaluated later.

Thematic analysis is carried out in two phases (Paillé & Mucchielli, 2012): themes identification and construction of the tree of themes. The first phase, themes identification, consists of reading the source text, page by page, and identifying units of meaning. These units are sentences or paragraphs that convey a meaning or idea. A theme must be assigned to each identified unit. Creating a theme is an inference process. In other words, by creating a theme, the analyst creates a more generic element compared to what is written in the text, and avoids, as far as possible, any interpretation. The second phase, construction of the tree of themes, is about comparing and finding connections between identified themes (Paillé & Mucchielli, 2012). For each connection, the analyst has a choice between four options: (1) merging themes if they are synonyms, (2) grouping them under a new parent theme if they concern the same matter, (3) hierarchizing them if one could be the parent theme of the other, and (4) subdividing a theme if it covers more than one concept. Paillé and Mucchielli underline the importance of grouping, which really helps in creating the hierarchical structure. According to them, analysts should strive to detect the same axes between themes in order to group them.

In this study, we went through the two phases of thematic analysis for each article or document of our data set. Paillé and Mucchielli (2012) qualified this approach as *progressive*. We stopped coding when we reached a stability in the emerged themes, that is when coding no longer brought new themes or restructure others.

At the end of the coding – thematic analysis in our case – we obtained a hierarchical structure of strategic alignment factors.

Creating the emerging model

Not all of the strategic alignment factors that we have obtained had the same importance. Furthermore, some of them weren't suitable for representing a factor of strategic alignment for a business application specifically, because IS is mostly considered as a subsystem of the firm in this research field. For these reasons, we applied a filter to eliminate, first, the factors that don't definitely reflect the alignment of a business application specifically and, second, those that came from only one text unit after

the coding. In the end, we obtained a tree structure of factors that were relevant for specifically reflecting what can be the alignment of a business application.

We designed the new model by taking the strategic alignment factors that were located closest to the root of the tree and using our theoretical framework as a guide. We took the first nodes of the tree to define the axes of the model and the second and third to define alignment links between domains. We established domains by being inspired by the four main components of our theoretical framework. In the end, we obtained a strategic alignment model that includes the business application surrounded by alignment links that are more detailed than in our initial theoretical framework.

RESULT

Strategic alignment factors

The coding process that we have applied on our qualitative data set, which was composed of scientific articles and public documents for practitioners, results in a hierarchical structure of strategic alignment factors. The final structure obtained after filtering less important and unsuitable factors is presented in Table 3 in the appendix.

In regard to this emerged structure, it appears that all factors of strategic alignment are classified either in the *managerial strategic fit* factor or in the *functional integration* one. This is in adequation with the SAM (Henderson & Venkatraman, 1993). However, we found that there were not just two alignment links under the *functional integration* factor as in the SAM, but three. Instead of functional integrations between business and IT strategies and between business and IS infrastructure, processes and skills, the three factors that we found were strategic integration, structural integration, and operational integration. Strategic integration represents the alignment between the business and IT strategies, and structural integration the alignment between business or organizational structure and the IS architecture. Finally, operational integration reflects how the IS enables business processes to be executed. These three alignment factors came while we were coding the article of Maes (1999), and they were relevant right through all the coding process. Thus, we confirmed the interest for “extending the vertical dimension” (Maes, 1999, p. 6) that Maes suggested. However, we can’t suggest “extending the horizontal dimension” (Maes, 1999, p. 7), because our coding process results only in factors related to links between business and IT and almost never exactly between business and information and between information and technology.

Business application strategic alignment model

The literature review of this study basically highlights two points. First, existing strategic alignment models are not suitable for evaluating a specific business application, and, second, that IS evaluation models such as ISSM do not incorporate strategic alignment factors or concepts. As we mentioned, we are convinced that a new model is necessary to more effectively address the issue of business application strategic alignment: a model that embraces, in detail, the links around the business application.

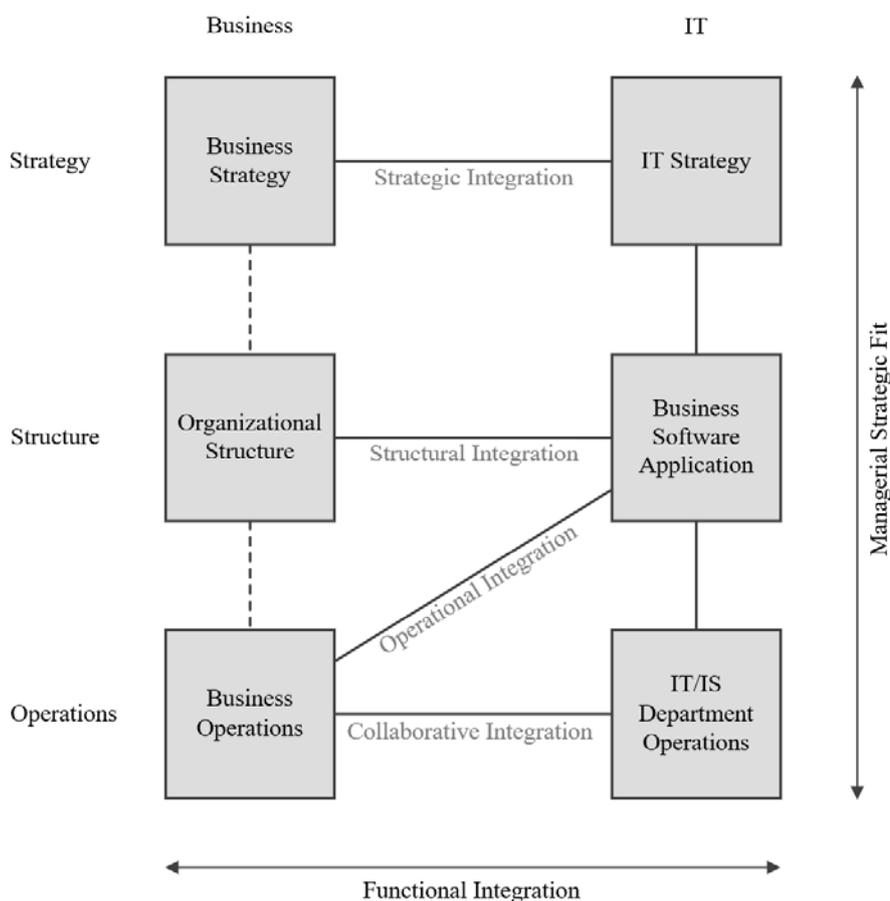
Through a process of coding and based on our theoretical framework, we propose a model that should help to understand the alignment links between a business application and (1) business and IT strategies, (2) organizational structure and (3) business and IT operations. This business application strategic alignment model (BASAM) is represented in Figure 2.

The horizontal axis, functional integration, comes from the SAM (Henderson & Venkatraman, 1993), while the vertical axis, managerial strategic fit, has emerged by coding two sources: the contribution of Henderson and Venkatraman (1993) for the strategic fit, and the model of Maes (1999) for the managerial aspect. Maes considers the managerial dimension as a compound of the three levels that are strategy, structure, and operations (1999) and this has also been incorporated in the model. Strategic integration and operational integration also arose from the SAM. The concepts of structural integration and collaborative integrations did not come from a particular model. We propose using these labels as they have been established in the tree structure of factors and as they seem meaningful.

The six domains

The six squares in Figure 2 are called *domains*, each encompassing specific aspects of a firm. Business strategy is the element that defines the firm’s business scope such as the choices of products or services and market positioning. This domain also defines the firm’s core competencies and what make it different from competitors. Also, business strategy includes aspects of business governance, such as decision-making on strategic alliances, partner selection, purchasing decisions, and merger decisions.

IT strategy defines the technological scope, which consists of taking decisions about using or not using existing technologies or new technologies available on the market in order to make the firm different from competitors. This also includes decisions about what competencies are required from IT employees, and also governance matters, such as decisions about alliances with IT service providers, choices between developing IT services internally or outsourcing and, finally, decisions about what IT standards to follow.



Source: This study

Figure 2: Business application strategic alignment model

The organizational structure includes the organization chart, the models of an organization's key processes, and the detailed framework or structure set in order to operationalize the business model of the firm.

The business software application is the IS as we have defined it in this study and from which we expect an alignment with other related domains such as business and IT strategies. It represents the structure of the business application: internal architecture, implemented software services, automated processes and embedded data structures.

Business operations include all business processes and tasks, from the design stage to execution and monitoring, as well as the acquisition and development of collaborators' skills related to the firm's core business, by offering trainings, courses, or cross-learning.

IT/IS department operations include all processes and tasks undertaken by IT/IS department staff, such as selection, development, configuration, deployment, and maintenance of software applications. This domain also includes setting up the management of a department's operations, such as providing a technical support service to users or adopting and deploying methods such as *Information Technology Infrastructure Library* (ITIL).

Six relevant alignment links

Strategic alignment is not evaluable by measuring these six domains, but rather by assessing the links between these domains. In regards to our model, there are eight links that were identified. We have found that two of them are not representative for evaluating the alignment of a business application: the relations between business strategy and organizational structure, and between organization structure and business operations. The other six turned out to be relevant for representing the strategic alignment of a business application.

The link between business and IT strategies, represented at the top of the model shown in Figure 2, is the most prevalent one in literature on strategic alignment. This alignment aims to determine how good the coherence between these two strategies is. It ensures that business matters are well considered when the IT strategy is established and that IT concerns and opportunities are well considered when the business strategy is drafted. This alignment is also about IT investments. It checks that IT investments are made in coherence with business strategy and that both businesses and IT managers have approved these investments.

Structural integration ensures that the application is integrated and managed in a common and centralized way for the entire organization, regardless of the departments involved. The existence, in a firm, of isolated business applications, such as *silos*, is an example of a poor structural integration. Structural integration is also the alignment between the business application and key business processes. Thus, an application that directly helps key business processes to be realized thereby improves the alignment level of this application.

Operational integration ensures that the application is useful to employees and efficient when they carry out their operations. The application must therefore correctly support all business processes. Business value provided by the application must also be formally demonstrated.

Collaborative integration is the level of collaboration between the users of the application and their IT/IS department colleagues who are in charge of the application. For effective collaborative integration, people must be able to communicate, to know each other, to have trust, and to show commitment to the collaboration.

Alignment between IT strategy and business application verifies whether choices made about technologies used for the application are consistent with existing technologies on the market. This alignment also concerns the relevance of alliances with external partners, and checks whether the application was something formally planned in the IT strategy or not.

Alignment between the business application and IT/IS department operations measures the ability of the IT/IS department to maintain and upgrade the application.

The resulting model shown in Figure 2 suggests that the six alignment links of a business application must be well appraised in order to consider this application as strategically well aligned.

Discussions

The emerged model of business application strategic alignment confirms that, first of all, IS evaluation is not only about evaluating the success (DeLone & McLean, 2003, 2016) or the technology acceptance (Venkatesh et al., 2003) but should also include alignment with strategies, organizational structure, and the IT/IS department's operations. This is important, because it could explain why the expected net benefit is sometimes not consistently achieved by the use of IS and sometimes not by its related user satisfaction either.

Secondly, results show that existing strategic alignment models are unlike the model that has emerged in this study. This confirms the need to develop a new strategic alignment model that is able to evaluate a specific business software application.

Thirdly, our study emphasizes the need to evaluate strategic alignment between all the components involved rather than only two of them such as alignment between business and IT strategies. This suggests that a business application could have some degree of alignment, even if the application is not specifically considered as a strategic information system. A business application that doesn't support business strategy, but has good structural, operational and collaborative integrations, may therefore be considered as a well-aligned application, without specifically being a strategic information system.

Considering that the emerged model was built through coding that used several scientific papers and public documents, it should not be specific to a particular context and should rather be generalized to various situations. Since Cumps et al. (2006) has highlighted that strategic alignment is not dependent on country, company size or turnover, the model should not be affected by any of these factors.

CONCLUSION

Assuming that there was no existing model capable of addressing the issue of evaluating a business software application through strategic alignment factors, we have designed a new strategic alignment model specifically suited to that purpose. Our research question was: *How can we evaluate a business software application using strategic IT alignment factors?* According to the results we have obtained, we can now answer that a business software application can be evaluated through an assessment of the following six alignments: (1) strategic integration, (2) structural integration, (3) operational integration, (4) collaborative integration, (5) fit between IT strategy and the business application, and (6) fit between the business application and the operations of IT/IS department. These six alignments are represented as links between the business application and the other domains shown on the emergent model. Thus, this model should help researchers to better understand relations between a business application and the strategies of a firm, its business structure and its business and IT operations.

Scientific implications

This study has highlighted a clear ambiguity with the concept of IS and more specifically with its scope. Indeed, IS is sometimes considered as a unique subsystem of a firm – which is specifically seen in the strategic alignment literature – and sometimes it is considered more as a software package or a business application – which is more the case in the IS evaluation field. For researchers, that means that we have to be careful about the meaning of IS and more specifically its scope.

For researchers working on strategic alignment, this study has highlighted that existing strategic alignment models focus mostly on the overall and unique IS of a firm. For researchers working on IS evaluation, we have concluded that existing models such as ISSM do not consider strategic alignment as a success factor. Thus, we call for further research studies that combine these two fields. The model that has emerged in this study gives a first framework to help in understanding the overall issue.

Managerial implications

The accelerating digital transformation requires firms, more than ever, to keep competitiveness and to ensure an effective business strategy and an effective strategic alignment. It is important for firms to have IS aligned with the strategy. For them, if each IS is well aligned, the global performance should be ensured.

Limitations and directions for future research

The first and most important limit of our study is the selected set of scientific papers and public documents for coding, which could be insufficient to represent the wider aspects of strategic alignment. However, since we didn't extract any important new code while coding the last documents, from all those we have selected, we think that we have reached a saturation. Thus, we think that coding new sources wouldn't have brought any further aspects into the emerged model.

The business application strategic alignment model is not yet validated and must be operationalized. Each link should be tested, and the impact of each one should be measured over the net benefits. This also involves the need for developing a method to evaluate a business application through strategic alignment, based on the emerged model. In future research, the level of a business application strategic alignment has to be used as a factor in IS success and should determine whether strategic alignment influences the intention to use, the effective use, and the user satisfaction.

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APPENDIX: Strategic alignment factors

Table 3 presents the strategic alignment factors obtained after the coding and filtering process. Explanations about acronyms used in the *Source* column are described in

Table 4. The source informs the reader about the article(s) or document(s) from which each factor has been extracted during the coding.

Table 3: Hierarchical structure of strategic alignment factors

Strategic alignment factor	Source
Managerial strategic fit (external-internal)	HV, MA
IT strategic fit	HV
Alignment between IT strategy and IS architecture	HV, MA
Consistency of technological choices	HV, C1, IC
Consistency of IS with IT strategy	CU
Existence of external strategic alliances	HV, C1
Existence of policies and IT standards	C3, IC
Existence of IT strategy	HV, C1, IC
Architecture agility	HV, LU, IC
Alignment between IS architecture and operations	HV, MA
Functional integration (business-IT)	HV, LU
Operational integration	HV, MA
Alignment between business operations and IS architecture	
Alignments of IS with business processes	LU, CU, C3, IC
IS flexibility leveraging responsiveness to business needs	LU, C1
Maturity of business value created by information systems	HV, LU, CU, C1, IC
Maturity of relations between IT department and business collaborators	
Ability to minimize resistance to change	LU, CU, CI
Maturity of communications	LU, CU, RB
Mutual understanding	
Business collaborators' understanding of IT and its impacts	LU, CU, C1, IC
IT collaborators' understanding of business operations	LU, C1, IC
Common language between IT and business collaborators	CU, OS, C1
Existence of means of communication	LU, RB, C1, C2
Existence of direct communication	RB, C1
Knowledge sharing	LU, RB
Partnership maturity	LU, CU
Trust between IT and business collaborators	LU, RB
Existence of programs that encourage the relationship	LU, CU, RB, C1
Perception of IT as a contributor of value	LU, CU, IC
Willingness and shared commitment	C1
Existence of a commitment to collaboration	LU, IC
Existence of incentives for willingness to collaborate	CU, IC
Strategic integration	HV, SC
Existence of a governance structure	LU, CU, RB, C1, C3, IC
Relevance in prioritizing IT investments	HV, LU, C1, IC
Prioritizations are approved both by IT and business	LU, C3, IC
Prioritizations are made according to the creation of value or competitive advantage	LU, C1, C3
Prioritizations consider business and IT strategies	CU, IC
Business line takes IT into account	
Consideration of IT in business strategy	
Consideration of IT constraints in business strategy	C1
Consideration of the potential of ICT in business strategy	HV, CU, C1, C2, IC
IT/IS department take business line into account	
Understanding of business strategy by the IT department collaborators	LU, C1, C2
Participation of business collaborators in IT strategy planning	LU, IC
Consideration of the business in the IT strategy	RB, CU, C1, IC
Structural integration	HV, CU, MA
Existence of a unique and centralized IT department all over the company	CU
Integration of information systems between departments	LU, IC

Source: This study

Table 4: Caption

Identifiant	Reference
HV	Henderson et Venkatraman (1993)
SC	Sabherwal et Chan (2001)
LU	Luftman (2000)
CU	Cumps et al. (2009)
RB	Reich et Benbasat (2000)
MA	Maes et al. (2000)
OS	Osterwalder et al. (2005)
C1	Phelizon et Rouhier (2002) (Cigref)
C2	Phelizon (2007) (Cigref)
C3	AFAI (2006) (Cigref)
IC	Dhugga et Addison (2011) (Strategic ICT)

Source: This study

For more information about these sources, please refer to Tables 1 and 2.

Case Study: Cainiao and JD.com Leading Sustainability Packaging in China

(Full Paper)

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ABSTRACT

This case looks at the packaging waste problems created by increasing e-commerce in China and its development of recycling policies. This case introduces the concept of Green supply chain, sustainable packaging in particular and discuss the development of sustainable packaging in China. We also look at best practices implemented by other companies and countries. The case is for the purpose to compare advantages, disadvantages and limitations of sustainable packaging and traditional packaging, to evaluate the impact of sustainable packaging, and to recommend ways for businesses to implement sustainable packaging without increasing the cost for long term.

Keywords: Sustainability, packaging, logistics, case study.

*Corresponding author

INTRODUCTION

Already the world's largest, China's online retailing marketing was expected to more than double in size, from US\$750 billion in 2016 to US\$1.7 trillion by 2020. The number of online shoppers in China was also expected to grow from 460 million in 2016 to 660 million users in 2020 (Erickson, 2019). The surging online business required lots of packaging materials.. In 2016, over 31 billion parcels were delivered, which equaled to 23 parcels per capita according to China's State Post Bureau. For each parcel, retailers and delivery companies could use up to seven types of packaging material such as cardboard, plastic bags and bubble wrap. Often, the amount of packaging used to protect goods was in excess of what was needed to reduce the risk of damage during transport. Most of this packaging went straight to landfills.

Whilst both paper and plastic could be recycled, less than 10 per cent of the paper and plastic packaging material ended up being recycled, and overall, less than 20 per cent all packaging materials in China were recycled. Instead most of this packaging went straight to landfills. Many of the materials were not biodegradable, and some even contain chemicals such as plasticizers and fire retardants that could present risks to human health.

The Chinese Government did not regulate the environmental impacts and recycling of e-commerce packaging. The State Post Bureau actively promoted green packaging in the delivery industry, and aimed to "build a recycling system and eliminate all harmful materials from packaging by 2020", but the lack of relevant legislation, regulation or strong policies was still one of the major barriers to tackling the mounting packaging waste. The cost of packaging to the environment and human health has yet to be factored in the market pricing mechanisms, which meant that companies did not have financial incentives to choose more sustainable options (Luo, 2017).

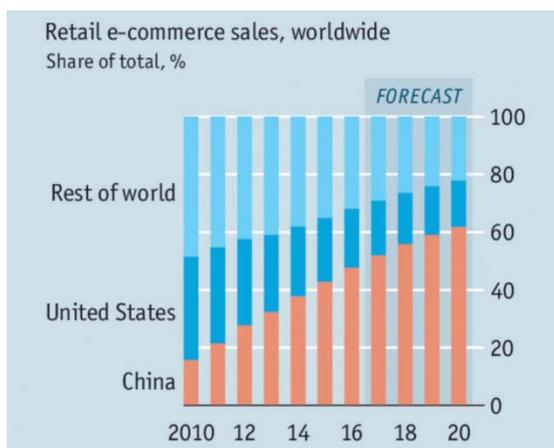
E-COMMERCE GROWTH IN CHINA

China led the world in e-commerce. More than 40% of the world's e-commerce transactions currently took place in China, up from only 1% about a decade ago. Tech champions such as Alibaba Group, Tencent and JD dominated the rapidly growing Chinese e-commerce ecosystem. They together occupied more than 85% of China's e-commerce market. China's online retail market was expected to reach USD1.8tn in 2022, thanks to local tech titans Alibaba and JD.com, according to a report by Forrester. The report revealed the Chinese online retail market would reach USD713bn in 2022, more than double the US and 10 times bigger than Japan at \$159 bn. With 38% of China's total population shopping online there was plenty of room for growth and it was expected China's e-commerce market would reach \$1.1 trillion in 2018, making it the world's first trillion-dollar e-commerce market in the world.

Statistics showed 76% of all e-commerce in China happened via mobile devices and mobile payments remained the most popular choice for online purchase with 80% of metro Chinese shoppers using Alipay and 66% using Tencent's WeChat Pay to pay in the last three months. What was surprising is Chinese consumers were found "the most demanding, advancing, and innovation-hungry digital shoppers", with 72% ranked as Progressive Pioneers compared to just 25% of US consumers (Long, 2018).

Another important trend to note about China's e-commerce growth lied in the potential users in the rural areas. Recent researches have shown a sign of urban market saturation but they have revealed the older demographic of China's population, typically living in the Western rural areas of China, presents immense growth potential for e-commerce retailers, with 241 million of people aged over 60 were accounted for nearly 20 percent of China's total population. These untouched older

demographic with the potential for infrastructure development and government-backed initiatives made the rural areas the next growth sector with huge potential.



Source: <https://www.weforum.org/agenda/2018/09/five-trends-shaping-the-future-of-e-commerce-in-china/>

Figure 1: Retail e-commerce sales figures worldwide

Rural Western-based users made up only 27 percent of all internet users in China with the majority of infrastructure developments were focused on China’s Eastern areas. Alibaba’s Taobao shopping app has recognized only recently this fact and started to shape their marketing strategies to target those 50 and older (Harsono, 2018).

Cainiao Network and JD Logistics, which were the logistics arms of Alibaba and JD.com, the two largest e-commerce firms in China. Their approaches and development on sustainable packaging were always the role models not only the logistics industry but also the e-commerce industry.



Source: <https://seekingalpha.com/article/4132604-jd-com-vs-alibaba-comparative-study?page=2>

Figure 2: JD’s national warehouse network and last-mile reach

Cainiao Establishment

Cainiao Network was the logistics alliance launched by Chinese e-commerce giant Alibaba Group in 2013. It provided a logistics information platform that linked a network of delivery partners, warehouses, and merchants to make package deliveries faster and more efficient. Cainiao’s business covered express delivery, warehouse fulfillment, last-mile delivery, rural logistics and cross-border logistics. Cainiao Network connected 6.1 million delivery routes, 2 million couriers, over 40,000 pick-up stations, 3,000 transportation companies, 30,000 rural villages, and 15 leading express delivery companies (CIW, 2017). In 2018, daily processed package volume was 100 million and exceeded 1 billion weekly.

JD Logistics Establishment

JD.com, China's largest online retailer to provide smart supply chain established JD Logistics on April 25, 2017 and logistics served by using the company's advanced technology and logistics expertise. Leveraging the unparalleled access to data from every step of the e-commerce process, from ordering to delivery and after-sales service, JD Logistics stated it would use AI, big data and automation to redefine the potential of e-commerce logistics. It aimed to provide business partners with comprehensive supply chain solutions, including warehousing, transportation, delivery, after-sales service, as well as logistics services, including smart and cross-border logistics. JD.com had one of the largest fulfillment infrastructures of any e-commerce company in the world. JD.com operates 256 warehouses, as well as 6,906 delivery stations and pickup stations across China, which were staffed by its professionally trained employees, providing nationwide last-mile delivery service (JD, 2017). In October 2018, JD.com launched a parcel delivery service in China to enable consumers in Beijing, Shanghai, and Guangzhou to send packages inter-city and across mainland China via the JD.com mobile app. The service includes various timing, for example same-day or two-day delivery, and high-value items such as luxury products and high-end consumer electronics. It aimed to expand the courier service to any residential and business customer in Mainland China (Yu, 2018). JD built the world's first fully automated warehouse in Shanghai, and they currently were developing their own drones delivery and automatic delivery robots (JD, 2019).

E-COMMERCE IMPACT ON ENVIRONMENT

China's Singles' Day online discount sales bonanza on Saturday saw bargain-hungry buyers spend over 254 billion yuan (\$\$52 billion), flooding the postal and courier businesses with around 331 million packages - and leaving an estimated 160,000 tonnes of packaging waste including plastic, cardboard and tape. The annual Nov 11 buying frenzy was a regular fillip for giant online retailers like Alibaba and JD.com.

China's State Post Bureau (SPB) said postal and courier companies were having to deal with at least 331 million packages, up 31.5 per cent from last year. Greenpeace described the annual promotion as a "catastrophe for the environment" that not only creates waste, but leads to a surge in carbon emissions from manufacturing, packaging and shipping. In a report published last week, it estimated that total orders last year produced 52,400 tonnes of additional climate-warming carbon dioxide. Official data showed China's courier firms delivered around 20 billion orders in 2015, using 8.27 billion plastic bags, 9.92 billion packing boxes and enough sticky tape to go around the globe more than 400 times. Overall deliveries continued to surge, with the number of packages expected to hit 50 billion next year, up from 30 billion in 2016, according to forecasts by the SPB (The Straits Times, 2017).

As we have seen the tremendous growth of e-commerce in China and the expeditiously growing parcel volume, excessive packaging and actual delivery from the logistics hub to the end-users, namely last-mile delivery created many environmental problems, just to name a few such as traffic congestions, waste problems and air pollution. All E-commerce companies around the world were facing the same issues and they have been working hard to come up with innovative ideas and adopting latest technologies to achieve sustainability.

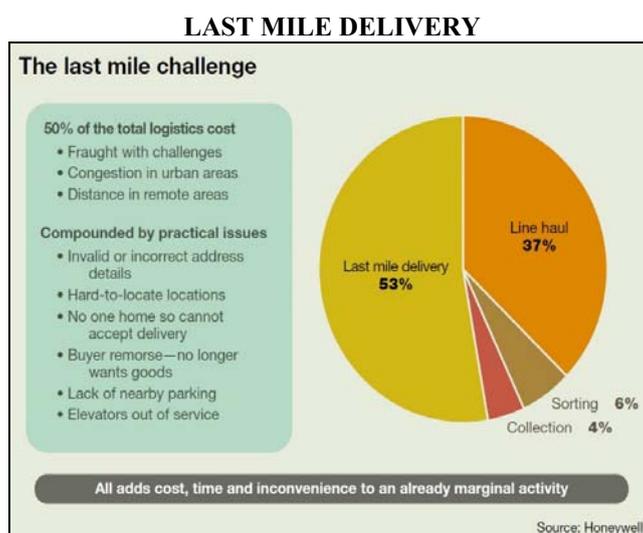
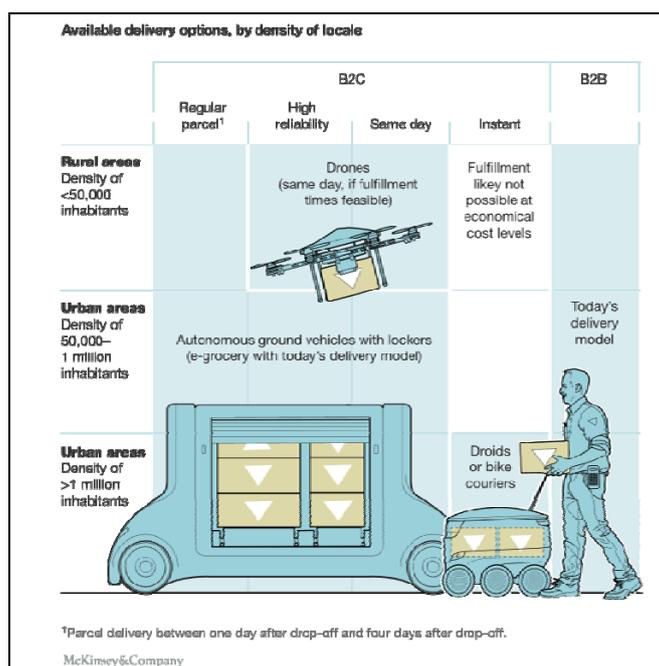


Figure 3: From DC to Final Destination: Last Mile Dilemma

According to Business Insider, Last mile delivery was defined as “In a product's journey from warehouse shelf to customer doorstep, the "last mile" of delivery is the final step of the process — the point at which the package finally arrives at the buyer's door. In addition to being a key to customer satisfaction, last mile delivery was both the most expensive and time-consuming part of the shipping process” (Dolan, 2018).

Rising labor costs and other overheads would provide challenging headwinds for the sector in the coming years. But so much of the infrastructure, such as fulfillment centers and parcel lockers, was already in place (Sololongom *et al.*, 2019).



Source: <https://medium.com/@miccowang/delivery-robots-as-last-mile-solution-aebebe557ad4>

Figure 4: Various models were likely to dominate last-mile delivery, given available product options density, and customer preferences.

ENVIRONMENTAL MEASURES OF EUROPEAN COUNTRIES

In year 2018, the European Commission published its new Plastic Strategy as part of the broader 2015 EU action plan for the circular economy and of the 2008 Waste Framework Directive, would also contribute to reaching the Sustainable Development Goals, the Paris Agreement and the EU's industrial policy objectives, which includes the following strategies:

- All plastic packaging in the EU marketplace must be either reusable or recyclable in a cost-effective manner by 2030,
- Recycle 55% of plastics by 2030,
- Develop strategies to integrate plastics value chains to promote market development (QC Polymers is a great example),
- Remove recycling-hampering substances from products,
- Develop standardized eco labeling criteria
- Consider policy tools to better manage marine litter

The commission aimed at ensuring that, by, 2030, all plastic packaging was reusable or recyclable in a cost effective manner (Davis 2018). In the US, Walmart issued recently a new set of waste reduction commitments around plastic packaging for its private brand program with the following commitments:

- Target at least 20% post-consumer recycled content in private brand packaging by 2025
- Seek to achieve 100% recyclable, reusable, or industrially compostable packaging for its private brand packaging by 2025
- Label 100% of food and consumable private brand packaging with the How2Recycle® label by 2022
- Work with suppliers to eliminate the non-recyclable PVC packaging material in its general merchandise packaging by 2020
- Reduce private brand plastic packaging when possible, optimizing the use to meet the need

Chinese government introduced measures to promote sustainable packaging in logistics industry including setting up green packaging guidelines, tax reduction and incentive programs. They suggested reducing parcel-packaging materials, using more electronic bills and increasing recycling efforts. The new guidelines were part of the country's 13th five-year plan for a cleaner and greener China. Government aimed to increase environmental protection efforts, cut carbon emission and develop cleaner technologies.

SUSTAINABILITY MEASURES OF CAINIAO AND JD.COM

The annual famous Nov 11 Singles' Day shopping festival was the most important date for online retailers like Alibaba and JD.com. Total sales hit 254 billion yuan with 1.38 billion orders placed. The mountain of trash produced from just one day have created serious concerns from environmentalists like Greenpeace. Nie Li, toxic campaigner at Greenpeace stated that 160,000 tonnes of packaging waste including plastic, cardboard and tape were produced. E-commerce firms have drawn up

measures aimed at solving the problem, and aim to replace cardboard boxes with reusable plastic ones that courier companies can share. They have also experimented with biodegradable delivery bags and tape-free boxes, but Nie said the efforts were still not enough (Stanway, 2017).

Cainiao Smart Packaging

Cainiao started a green logistics initiative in 2013 with 32 Chinese International partner, focusing on green solutions such as promoting the use of greener packaging and recycling, adopting electric delivery vehicles in nearly 20 cities, and applying big data to improve efficiency in logistics. In 2015 the project saved 1 billion packing boxes and delivered 0.5 million parcels packed in 100 percent bio-degradable materials to consumers. The project aimed to reduce 3.62 million tons of carbon emissions from the industry by 2020 (Luo, 2017). In 2016, Cainiao Network, Alibaba Foundation, China Environmental Protection Foundation, and the six largest logistics companies in China established the Cainiao Green Alliance Foundation. An investment of 300 million Yuan has been planned for research use to promote green logistics, consumption and supply chain management.

Investor	Speciality	Share	Role in Cainiao
Alibaba	Ecommerce	43%	Data platform, financial reconciliation
Yintai	Property	32%	Warehouse management
Fosun	Conglomerate/Investments	10%	Warehouse construction
FORCHN.com.cn	Conglomerate/Logistics	10%	Line-haul
YTO.net.cn	Logistics	1%	Last mile
SF	Logistics	1%	Last mile
STO.cn	Logistics	1%	Last mile
YundaEx.com	Logistics	1%	Last mile
ZTO.com	Logistics	1%	Last mile

ecommerce^{IQ}

Source: <https://ecommerceiq.asia/cainiao-logistics-southeast-asia/>

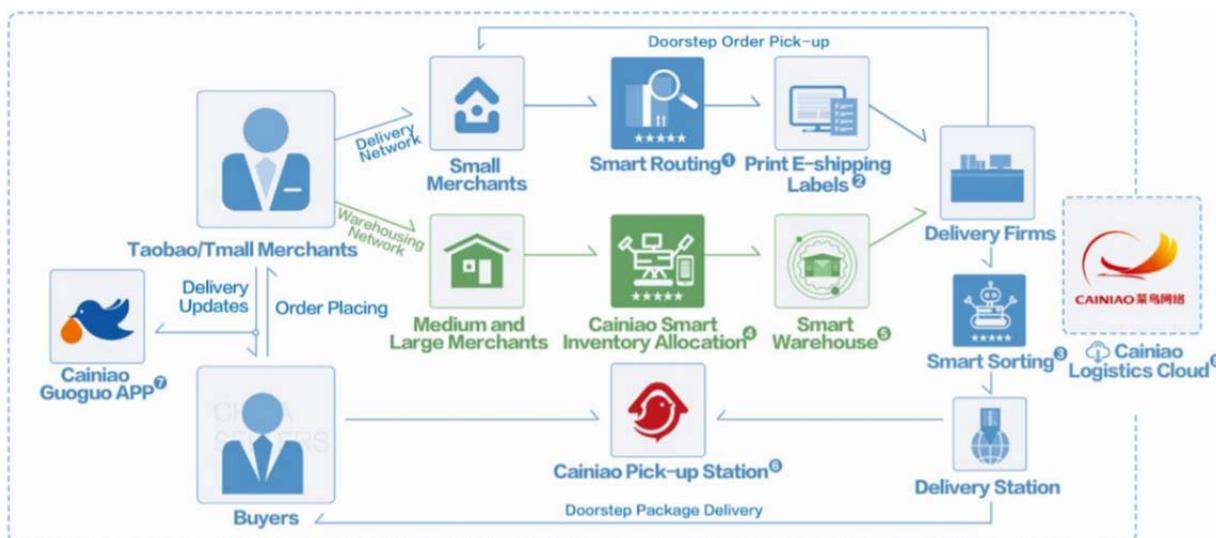
Figure 5: Cainiao Business Model

In the year of 2018, Cainiao adopted advanced technologies to increase its sustainability effort including its smart-packaging technology to reduce 15% of wasted materials and improved packaging efficiency for over 510 million parcels. Wang Pan, head of the Cainiao Logistics Cloud division, which provides enterprise solutions such as the smart-packaging algorithm said “All sellers have to do is to insert the length, height and width of their products and the order history, and the system will automatically recommend the right size,” “When a new order comes in, it will suggest a box that matches the area of the shipments, as well as the order in which the box should be packed and item combinations.”

- Real-time recommendation to merchants on the best delivery option;
- E-shipping labels for easy package identification and tracking;
- smart sorting provides delivery firms with the best route option;
- Based on past sales data, smart inventory allocation helps merchants stock up products in the nearest warehouse;
- Cainiao partners’ smart warehouses enhance efficiency in packaging and despatching;
- Cainiao pick-up stations provide the last-mile delivery solution;
- Cainiao Guoguo App provides one-stop order placing, package tracking and other logistics services;
- Cainiao collects data throughout the logistics chain and share it with partners on its cloud platform;

On top of smart packaging, Cainiao also set up “Cainiao Recycling Project” on Alibaba’s navigation app Amap to direct customers to the closest recycling stations, for every box recycled, they scanned a QR code via their Mobile Taobao, Cainiao or Alipay apps to received “green power” points on Ant Forest, a popular game inside the app that tracked users’ carbon footprints. 5,000 recycling stations to collect shipping boxes at different delivery points, schools and commercial buildings in 200 cities. It has collected over 3.5 million boxes for recycling.

For the B2B wholesale segment, Alibaba’s 1688.com featured sustainable-packaging vendors selling related items, ranging from biodegradable delivery bags to boxes that didn’t require sealing tape. Another subsidiary Tmall Supermarket also changed its duct tape to thinner plastic, with messages written on top to remind customers to separate the plastic tape from cardboard boxes. This would help recycling facilities time and energy spent on removing plastic from recyclable boxes. To take steps forward, Cainiao joined efforts with the Alibaba group in the Alibaba Green Logistics 2020 to improve recycling, packaging, route-planning and delivery methods to reduce waste and promote sustainability. Alibaba CEO Daniel Zhang stated it was very important to make products are close enough to customers before they get sold by reducing package numbers and innovating in new materials (Chou, 2018).



Source: <https://www.alizila.com/wp-content/uploads/2016/09/Cainiao-Factsheet.pdf?x95431>

Figure 6: Cainiao's Delivery and Warehouse Network

Alibaba's Cainiao logistics arm said in emailed comments that it had launched initiatives aimed at minimising its environmental impact. "We are committed to work closely with different stakeholders to protect the environment and contribute to the sustainable development of the industry," it said (The Straits Times, 2017).

JD.com's Green Actions

"China's online retail giants have taken few real steps to reduce delivery packaging waste," she said. "Ultimately, packaging that we throw out after one use is not a sustainable option." A spokesman for JD.com said it was "continually improving ways to better reduce waste and pollution" and, among other measures, aims to raise the proportion of biodegradable materials in its packaging materials to 80 per cent by 2020 (The Straits Times, 2017).

In 2018 JD.com launched its eco-friendly packaging programme which allowed customers to select the reusable packaging option on the billing page while placing orders and return the green box to the delivery personnel after receiving their order. Under this new programme, JD.com would deliver small and medium-sized parcels in reusable packaging and it was expected to save RMB32.5 million annually. It introduced the free service in Beijing, Shanghai, Guanzhou and Shenzhen and target to expand to 20 cities by the end of 2018 (Packaging Gateway, 2018).

Due to the problems of air pollution and traffic jams, JD.com has adopted advanced technology for solutions and it developed drones, AGVs and parcel lockers to increase efficiency and also lessen the impact on environment. JD was the first company in China to use drones to deliver parcels in rural areas in China. It obtained a license to operate drones on a provincial level for logistics purposes, the first company in China to do so. JD had setup logistics operations using drones in seven provinces, including Shaanxi, Jiangsu, Hainan, Qinghai, Guangdong, Fujian and Guangzi. They mainly delivered goods to rural areas that are hard to reach.

JD converted more than 5,000 of its delivery vehicles to new energy and it expected to reduce an estimated several million tons of CO2 emissions after it entire fleet go green. JD also encouraged its manufacturers to adopt more sustainable processes to reudce the impact on environment especially on natural resources. JD also educated its customers about sustainability through its partnership with green advocacy groups like the United Nations Development Programme to let people know how to change their consumption habits and launched a recycling program for used items sent to charities and non-profit organizations to reduce waste and help people living in poverty (Wang, 2019).

DISCUSSION AND SUMMARY

Comparison Of Traditional Packaging And Sustainable Packaging

	<i>Sustainable Packaging</i>	<i>Traditional Packaging</i>
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Advantages	<ul style="list-style-type: none"> – More environmental-friendly: reduce package material waste with greener packaging and make recycling easier. – Reduce carbon emissions significantly and improves packaging efficiency. – Save money by recycling materials and reduce the effort/time on recycling. 	<ul style="list-style-type: none"> – A mature supply chain with suppliers along the chain can work with each other easily. – Enough capacity to meet the fast demand of e-commerce. – Provide protection to goods with low initial cost
Disadvantages	<ul style="list-style-type: none"> – Require initial investment on green solutions (e.g. use biodegradable materials, set up recycling processes and adopt electric delivery vehicles) – R&D cost of new materials is high: need to re-design the original packaging, route-planning and delivery methods. – Require a high degree of information technology adoption. 	<ul style="list-style-type: none"> – Environmental issues: recovery rate is low, hazardous chemical waste risky to human health. – Non-biodegradable materials also cause various pollutions and excessive carbon emissions.
Limitations	<ul style="list-style-type: none"> – Regulation not to mature stage. – Companies have no incentive to adopt more sustainable options, especially SMEs who often face technical barriers such as IT adoption. – Challenges associated with changing consumer behaviors. 	<ul style="list-style-type: none"> – Most of the packaging materials available on the market are not biodegradable. – Most of the packages are thrown away after one use, even though they are still within their useful lifetime. – There lacks regulation to evaluate the environmental impact caused by non-recyclable materials.

Role Of Sustainable Packaging In Improving The Traditional Supply Chain Management

The adoption of sustainable packaging with advanced technologies can improve supply chain management and increase customer satisfaction. The following is one example from Cainiao. The last mile in the shipping process is the most time consuming and expensive part, where the excessive packaging problem always occurs if the last-mile delivery is long. In order to overcome this issue, Cainiao applied big data analysis to improve the delivery efficiency. For instance, it printed e-shipping labels for tracking and identification of the package. The delivery firm can use the information from the labels to sort packages and suggest optimized routes to customers, and there are no additional labels needed to identify packages.

Moreover, with the implementation of information technology, various firms along the supply chain can share data with the others. With such data sharing, the packaging algorithm not only can suggest the most suitable package to be used in delivery, but also facilitate effective forecasting and inventory building. In addition, the products can be shipped in bulk load to the warehouse and then dispatched to customers. This saves packaging materials as well as the last mile delivery cost.

Evaluation Of The Impact Of Sustainable Packaging

The implementation of sustainable packaging is certainly bringing impact to the environment, society and economy.

- *Environmental impact.* Prior to using biodegradable materials, the traditional packaging used many types of non-recyclable packaging materials which worsened issues such as plastic waste, carbon emissions and even traffic congestion. However, by implementing sustainable packaging, the pollution problems can be eased. Some examples include: 1) The adoption of smart-packaging technology by Cainiao in 2018, which reduced wasted materials by 15% to improve packaging efficiency for over 510 million parcels; and 2) Adoption of advanced technology (e.g., drones, parcel lockers) by JD.com, which helped increase delivery efficiency and relieve burden on the environment by converting more than 5,000 of its delivery vehicles to run on renewable energy.
- *Social impact.* In aligning with worldwide initiatives on sustainable development, companies which use sustainable packaging can gain public recognition on the effort it makes on environmental protection. By taking these actions, companies can also deliver on their corporate social responsibility commitment and create win-win situations. Examples here are: 1) In the “Cainiao Recycling Project”, Alibaba allowed its customers to find the nearest recycle station and earn “green points”. This initiative can change consumer habits and increase the cost-effectiveness of the recycle business; and 2) JD.com has a consumer education program focused on sustainability through its partnership with the United Nations Development Program. The initiative allows people to learn about how to change their consumption habits and launch recycling programs for used items sent to non-profit organizations.
- *Economic impact.* The adoption of sustainable packaging brings expansion opportunities for the recycle business. Sustainable packaging materials could be a new investment area for many venture capitals companies. The initial cost might be high, but in the long run when it matures, the entire supply chain should benefit in a cost-effective manner. JD.com showed a good example here, with the new eco-friendly packaging program, it delivered small and medium size parcels in reusable packaging, and it was expected to save RMB 32.5 million annually.

Recommendation For Implementation

In order to eliminate the waste of packaging materials throughout the entire supply chain and reduce the distance of last mile delivery to the consumers, there are many potential solutions that businesses can implement in terms of sustainable packaging without increasing costs for the long term.

- *Forming a Strategic Alliance* – partners within the alliance will share costs, professional skills, returns and most importantly information so a seamless reuse along the entire value chain is possible. Aligning their objectives, particularly reuse objectives, will help align their interests and in turn their operations. As an extension of this alliance, they will also find ways to encourage consumers to use durable packaging in the last mile delivery.
- *Providing policies and regulations that incentivize reuse and recycle* – the government can use policy tools such as more favorable taxes to help the private sector overcome the initial cost barrier before the abovementioned alliance can achieve long term cost competitiveness
- *Socializing the reuse concept both within and without the alliance/industry* – this could lead to more desirable behaviors by industry practitioners and consumers such as: improve package design with a focus to minimize life cycle cost throughout the entire value chain which would solve the redundant packaging that prevails in the industry now; standardize both packaging materials and the packaging process which could simultaneously reduce waste and lower costs, improve operational efficiency and increase reuse opportunities; automate the packaging process to reduce labor cost and minimize waste that is often inevitable in a manual operation.

ROAD AHEAD

With the ever changing e-commerce world and all companies were working hard to take the winning edge in the business, customers were also increasing their expectations in both online shopping experience and faster deliveries, therefore costs were also increasing for these e-commerce companies in terms of labor and adopting advance technologies, would Cainiao and JD.com be able to sustain its leading positions in the e-commerce market? Would the e-commerce companies in China be able to overcome the challenges with increasing number of delivery volume? Would China be able to take a lead in sustainable packaging globally?

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Consortium Blockchain for Security and Privacy-Preserving in E-government Systems

(Full Paper)

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ABSTRACT

Since its inception as a solution for secure cryptocurrencies sharing in 2008, the blockchain technology has now become one of the core technologies for secure data sharing and storage over trustless and decentralised peer-to-peer systems. E-government is amongst the systems that stores sensitive information about citizens, businesses and other affiliates, and therefore becomes the target of cyber attackers. The existing e-government systems are centralised and thus subject to single point of failure. This paper proposes a secure and decentralised e-government system based on the consortium blockchain technology, which is a semi-public and decentralised blockchain system consisting of a group of pre-selected entities or organisations in charge of consensus and decisions making for the benefit of the whole network of peers. In addition, a number of e-government nodes are pre-selected to perform the tasks of user and transaction validation before being added to the blockchain network. Accordingly, e-government users of the consortium blockchain network are given the rights to create, submit, access, and review transactions. Performance evaluation on single transaction time and transactions processed per second demonstrate the practicability of the proposed consortium blockchain-based e-government system for secure information sharing amongst all stakeholders.

Keywords: E-government systems, Consortium blockchain, Validators, Security, Privacy, Decentralised systems.

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INTRODUCTION

The rapid advancement of Information and Communication Technologies (ICT) has made it possible to store and access vast amount of information effectively and efficiently in networked systems. E-government is one such system that uses ICT to deliver public services to citizens, businesses and other stakeholders. The transformation of government systems from traditional paper-based information sharing to its electronic counterpart increases the transparency, accountability, participatory, effectiveness and efficiency of services delivered by government agencies, resulting into a better government system (UN, 2018). In the future, the number of devices using e-government systems will increase dramatically due to the proliferation of technologies such as smart cities, internet of things (IoTs), cloud computing and interconnected networks (Yang et al., 2019; Elisa et al., 2018b). Commonly, as the number of devices using e-government systems rises, the number of malicious nodes trying to access and abuse unauthorised and sensitive information grows accordingly (Yang et al., 2019). The goal of an e-government system is to ensure that information security goals including integrity, confidentiality, availability and trust are met for its users. Thus, for the successful adoption of e-government systems, cyber security provision is of paramount importance (Lambrinouidakis et al., 2003; Elisa, 2017).

Data breaches in e-government systems have been significantly increasing in recent years based on various sources. For instance, according to the 2019 Cyber Security Breaches Survey by the UK government, around 32% of businesses and 22% of charities reported facing cyber security breaches or attacks in 2019, such as phishing, viruses, malware including ransomware attacks and impersonation of emails (UK Cyber-Attacks, 2019). In the United States of America, more than 5.90 billion data have been stolen by cyber criminals so far in 2019 (US Cyber-Attacks, 2019), including social security numbers, credit card numbers, names, passwords and addresses. Recently, 364 million Chinese citizens' sensitive information were leaked online by unknown hackers, revealing private information like user name, photos, address and identity card numbers (China Attacks, 2019). Another recent cyber security breaches in e-government systems happened in Tanzania where the country was hit by hackers and cyber-terrorists who caused a loss of around 85 million US dollars (IPP Media, 2018).

There is a demand for efficient and robust mechanisms to ensure information security and data privacy, due to the centralised nature of the existing e-government systems. Blockchain technology provides the decentralised environment for secure transaction processing in trustless systems. It is designed as an immutable and distributed database for protecting privacy and security of the shared transactions among its trustless participants. In fact, the blockchain technology has been successfully exploited for security and privacy provision in supply chain (Tian, 2016), healthcare system (Peterson et al., 2016), Internet of Things (IoT) (Dorri et al., 2017), land registry (Ramya et al., 2018), smart cities (Biswas and Muthukkumarasamy, 2016),

educational systems (Turkanović et al., 2018), in addition to the well-known e-currency. The blockchain technology can be public (permissionless), private (permissioned) or consortium (semi-public and semi-private). One type of blockchain technology that is designed to meet the need of the enterprise is the consortium blockchain. The consortium blockchain technology is a semi-public and decentralised blockchain system which consists of a group of pre-selected entities or organisations responsible for consensus and decisions making for the benefit of the whole network of peers.

This study proposes a secure and decentralised e-government system based on the consortium blockchain technology. Briefly, the proposed consortium blockchain-based e-government system consists of four layers namely the services access layer, consortium blockchain layer, network layer and ledger storage layer. The service access layer provides services to e-government users by connecting their devices to the consortium blockchain-based e-government system. The consortium layer includes a number of pre-selected e-government nodes for validating users and transactions before being added to the blockchain network. The network layer ensures the connectivity between different entities of the proposed systems. The ledger storage layer stores off-chain (sideDB) data such as images, PDFs, DOCs, contracts, and other files that are too large to be stored in the blockchain or that are required to be deleted or changed in the future. The performance evaluation based on the number of transactions processed per second and on the time for processing a single transaction by varying the number of validators in the consortium blockchain network have proved that, the proposed system is suitable for security and privacy assurance in e-government systems.

The remainder of this paper is organised into four sections namely background, consortium blockchain-based e-government system, performance evaluation and finally conclusion and future direction as follows.

BACKGROUND

This section details the background on the blockchain technology and e-government systems.

Blockchain Technology

The blockchain technology is a decentralised peer to peer (P2P) network that maintains a list of continuously growing shared database (ledger) running on the Internet. The transactions are chained together to form a “block” of records, thus named as blockchain. Each participant of the blockchain network has a pair of private and public key for signing and verifying transactions (Nakamoto, 2008). SHA-256 Cryptographic Hash Algorithm (Wolrich et al., 2014) is a commonly used to generate the hash value from the public key of each participant, which is then used as the participant’s identity. The participants of the blockchain network use the distributed consensus algorithms such as Proof of Work (PoW) (Nakamoto, 2008), Proof of Stake (PoS) (Mingxiao et al., 2017), Delegated PoS (Mingxiao et al., 2017) or Byzantine Fault Tolerance (Mingxiao et al., 2017), to agree on the validity and the order in which transactions are added to the blockchain network.

A blockchain ledger is illustrated in Figure 1. The first block known as the genesis is formed by hardcoding and embedding random transactions into the blockchain software (Nakamoto, 2008). The upper part of each block contains its header and the lower part contains the list of transactions (body). The header includes the cryptographic hashes of the current and previous block headers linked together to create a secure chain of blocks. The header also stores the timestamp, a nonce, block version, and the root hash of all transactions stored in that block. The timestamp is used to indicate the time taken (representing the difficulty) to mine and add the block. The block version indicates the validation rules followed to create the block. The nonce is a 4-byte unique random number which normally starts with 0 and increases for every next transaction. The root hash of the transactions is derived from a Merkle tree as shown in the lower part of Figure 1. In a Merkle tree, each leaf node contains a hash of a single transaction, and all non-leaf nodes store the hashes of their children. A typical Merkle tree consists of two (2) branches, making each node hold up to two children. The Merkle root summarises all transactions in the block so as to maintain the integrity of data in case of tempering.

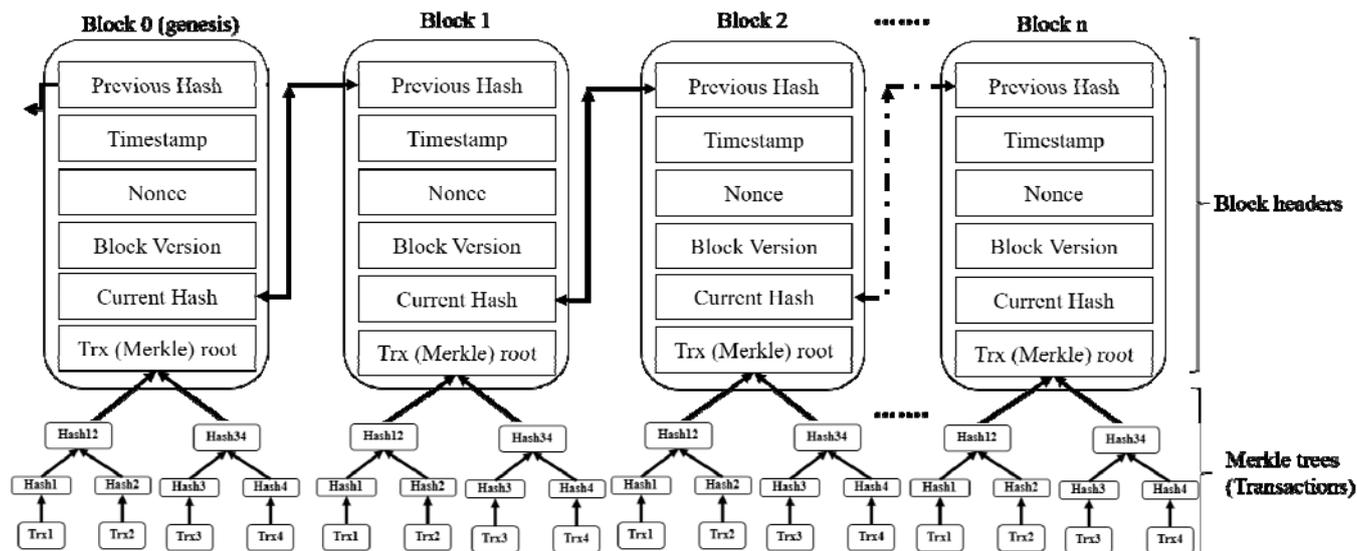


Figure1: An example of a detailed blockchain ledger.

Example applications of blockchain technologies include Bitcoin (support decentralised cryptocurrencies) (Nakamoto, 2008), Ethereum (support self-executing digital smart contracts) (Buterin et al., 2014), Hyperledger Fabric (support development of general enterprise solution) (Cachin, 2016), amongst others. Typically, the blockchain technology can be either public (permissionless), private (permissioned) or consortium (semi-public and semi-private) as detailed below.

Public blockchain: In a public blockchain, any individual can view, modify, and audit the blockchain without having a single entity in charge of the whole network. The consensus and decision making is reached through a decentralised consensus manner such as PoW in bitcoin (Nakamoto, 2008). The computation power of the participants of the blockchain network is used to select one participant powerful enough to add new transitions to the distributed ledger. The participants are incentivised every time when adding new transactions to the blockchain network, and thus this motivates everyone to use more computations to get the chance of adding transaction to the ledger. In public blockchain network, the higher the number of users, the more secure the network; as it creates a network of trusted individuals between the participants.

Private blockchain: The private blockchain is owned by an individual organisation who is responsible for granting access to the network for new users. Only few specific individuals in the organisations have rights to validate transactions and blocks, and append them to the blockchain network. It is centralised compared to the public blockchain.

Consortium blockchain: The consortium blockchain consists of a pre-selected set of nodes or computers that are responsible for controlling access to the blockchain network resources (Dib et al., 2018). The goal of the consortium blockchain is to eliminate the individual/single autonomy of the private blockchain by having multiple entities or organisations in charge of consensus and decision making for the benefit of the whole network of peers. Since only pre-selected organisations are allowed to validate transactions and consensus, incentives are not necessary in this network. The pre-selected set of nodes make it partially private, partially public and semi-decentralised. More precisely, it provides the benefits of public blockchain in terms of efficiency and scalability while still permit some degree of central safeguarding and monitoring like in private blockchain. The consortium blockchain such as Hyperledger fabric (Cachin, 2016) is designed to meet the needs of the enterprises where a group of collaborating agencies exploit the blockchain technology to improve service delivery. All consensus participants of the consortium blockchain are known and reputable, therefore, malicious users cannot join the network freely.

E-government Systems

E-government systems use ICT to provide friendly services to citizens and businesses across different government departments. The use of e-government web portals enables organisations in private and public sectors to interact directly regardless of their physical locations around the world, whilst simultaneously improving the quality, convenience, transparency, efficiency and effectiveness of public services. It is becoming a mandatory for most countries across the world to use digital communication between citizens, businesses and the government (UN, 2018). Additionally, the use of e-government makes public administrators and officials more democratic and responsible due to the provided tractability and transparency.

E-government systems are categorised into four groups including Government to Citizens (G2C), Government to Business (G2B), Government to its Employees (G2E), and Government to Government (G2G) (Karokola, 2012). G2C is the interaction between citizens and government via government web portals. G2B involves communication between the government and business partners or other corporate organisations to share information such as procurements, company registration and payment for licenses and taxes. G2E can be referred to as intra-government communication concerned with the sharing of the documents among employees of the government. G2G is the interactions with other governments as well as the internal

communication between government agencies or department by following the established rules governing public services delivery.

The existing technologies for delivering e-government services to citizens and other stakeholders include web portals, mobile phones (sms and mobile applications), and electronic identity (eID) (Stefanova et al., 2006). E-government web portal is an integrated application that serves as an entry to government websites to provide individuals direct access to online services provided by the government. Mobile government uses mobile phones within public administrations to deliver services to individuals. The eID is the digital identity which is assigned to citizen or an organisation to help the government to authenticate legitimate users (Stefanova et al., 2006). An individuals can use the same eID to access to different services offered by different public departments. eID solution can also be provided using mobile technologies (Stefanova et al., 2006). Common to these technologies is that, information collected from individuals are stored in centralised databases and servers. The centralised management systems can become a single point of failure or target to malicious users. Numerous artificial intelligence techniques such as (Yang et al., 2017; Elisa et al., 2018) have been exploited to develop intrusion detection systems (IDSs) that can also be used by e-government systems to enforce security, but they cannot be used to preserve privacy neither ensure decentralisation (Elisa et al., 2018b).

CONSORTIUM BLOCKCHAIN-BASED E-GOVERNMENT SYSTEM

The proposed consortium blockchain-based e-government architecture is illustrated in Figure 2. It consists of four layers including services access layer, consortium blockchain layer, network layer and the ledger storage layer. The services access layer comprises of e-government users and various devices for providing access, computing resource, and storage of user's credentials. The consortium blockchain layer is a P2P network of pre-selected e-government validators responsible for validating transactions and authenticating e-government users before joining the network. Also, the consortium blockchain layer is responsible for provision of various services to users including consensus, P2P communication, and users' identity management. The network layer is for providing the connectivity between users, e-government consortium blockchain network and the ledger storage. The ledger storage layer is for storing off-chain (sideDB) data such as images, PDFs, DOCs, contracts, and other files that are too large to be stored in the blockchain or that are required to be deleted or changed in the future. The requirement of the ledger storage layer is because the blockchain database is append-only and immutable, so there is no chance of deletion in the future. Each of these layers is detailed in the following subsections.

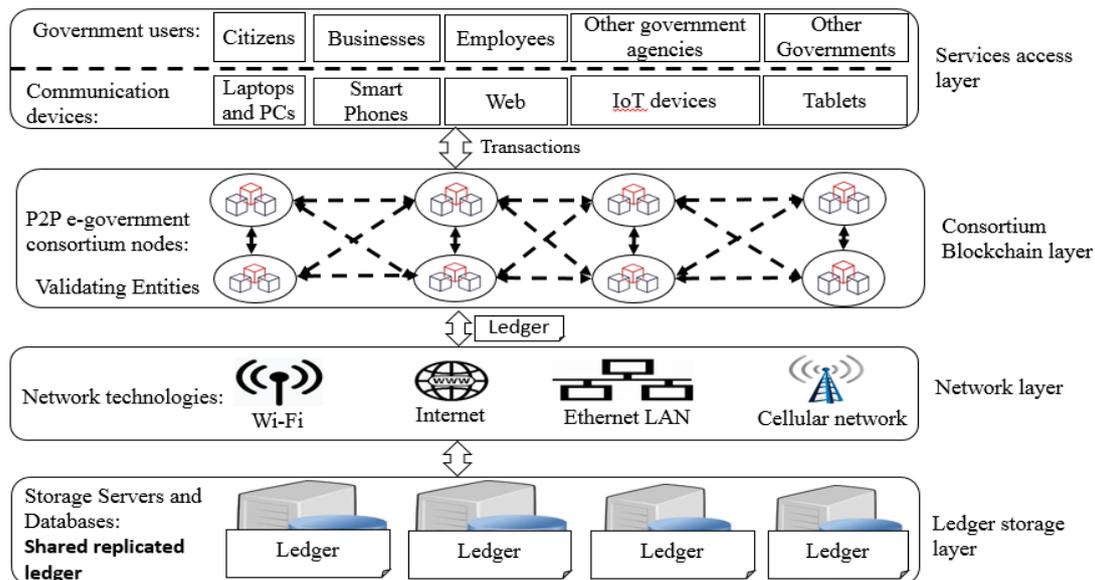


Figure 2: The proposed consortium blockchain e-government system.

Service Access Layer

This layer consists of e-government user information and various devices for providing access, computing resource, and storage of credential data. User's devices on this layer can be PCs, laptops, smart phones, tables, through which they can write or read data to the e-government consortium blockchain network. The devices at this layer will use blockchain interface embedded on web browser or mobile application to interact with the blockchain network of government consortium nodes.

Initially, when an e-government user signs up for government services, a private key, public key, identity and the corresponding blockchain address will be generated and stored in his/her wallet as illustrated in Algorithm 1. Note that, the blockchain wallet will be generated as soon as the user signs up with e-government system. The private key is for signing and authorising transactions where verification by other blockchain entities is done by using the corresponding public key.

Once an e-government user wants to access the service, the request is signed by the private key and get broadcast to the consortium blockchain of government peers. A copy of account information and transactions history for every user will be stored in the e-government consortium servers to facilitate account recovery in case the user loses the wallet password.

Algorithm 1 User Registration

input: New user request

output: Registered user u

```

1:  $(K_{pub}, K_{pr}) \leftarrow keysGeneration();$ 
2:  $ID \leftarrow userIDGeneration();$ 
3:  $wallet \leftarrow generateWallet() + (K_{pub}, K_{pr});$ 
4:  $BlockAddress \leftarrow generateAddress() + (K_{pub}, K_{pr});$ 
5:  $(ID, K_{pr}, K_{pub}) \leftarrow walletStore(uID, K_{pr}, K_{pub});$ 
6:  $storeWallet(wallet);$ 
7:  $u \leftarrow registeredUser();$ 

```

Consortium Blockchain Layer

The participants of this layer are the pre-selected government departments (validators), who are responsible for validating transactions and authenticating e-government user's registration with the consortium blockchain network. The departments that meet the requirements for pre-selected participants of the consortium blockchain network will be registered by using Algorithm 2. After registration, a node will receive a blockchain address, private and public key pair for signing and verifying transactions.

Algorithm 2 Adding pre-selected peer to the consortium network

input: A new participant node,

A set of N nodes in the current consortium network

output: Registered node m

```

1:  $(K_{pub}, K_{pr}) \leftarrow keysGeneration();$ 
2:  $ID \leftarrow peerIDGeneration();$ 
3:  $wallet \leftarrow generateWallet() + (K_{pub}, K_{pr});$ 
4:  $BlockAddress \leftarrow generateAddress() + (K_{pub}, K_{pr});$ 
5:  $(ID, K_{pr}, K_{pub}) \leftarrow walletStore(uID, K_{pr}, K_{pub});$ 
6:  $storeWallet(wallet);$ 
7: for each  $n \in \{N - m\}$  do
8:    $broadcastRegistration(n, m);$ 
9: end for
10:  $m \leftarrow verifiedValidator();$ 

```

A number of validators amongst the consortium peers are required to validate any transaction before being added to the blockchain ledger. For instance, the consensus could be reached if a transaction is verified by twenty departments in a consortium blockchain with fifty departments in total. Thus, the validators collectively sign off transactions, grant or deny access to the shared blockchain ledger. Note that, the ledger in this layer is permissioned since only approved participants of the blockchain network have the access privilege. Any change to the blockchain stored in the consortium layer will be reflected by all participants in their copies as soon as it is realised. Additionally, the consortium blockchain layer provides e-government users the rights to create and submit transactions, access, and review their transactions.

The process for creating and adding a block to the blockchain by the validators is illustrated in Algorithm 3.

Algorithm 3 Adding a new block to the consortium blockchain

input: A set of N participants in the consortium blockchain network,

A blockchain B including blocks from the genesis to b_n ,

Validation time T_c needed to create a block

output: A new block b_{n+1}

A new blockchain B'

```

1: Initialise an empty set of transaction  $R = \{\}$ ;
2:  $\omega \leftarrow electValidators(N);$ 
3: while  $validation\_time < T_c$  do
4:   for each  $n \in \{N - \omega\}$  do
5:      $R \leftarrow R + addTransactionFromUser(n);$ 
6:   end for
7: end while
8:  $b_{n+1} \leftarrow newBlockCreation(b_n, R);$ 
9: for each  $n \in \{N - \omega\}$  do
10:   $signnewBlock(b_{n+1}, n);$ 
11: end for
12:  $B' \leftarrow B + b_{n+1};$ 
13: for each  $n \in N$  do
14:   $broadcastBlockchain(B', n);$ 
15: end for

```

The boundaries formed by the consortium layer of blockchain nodes and e-government users is illustrated in Figure 3. The communication between the consortium blockchain network and the services access layer happens on demand when users submit transactions.

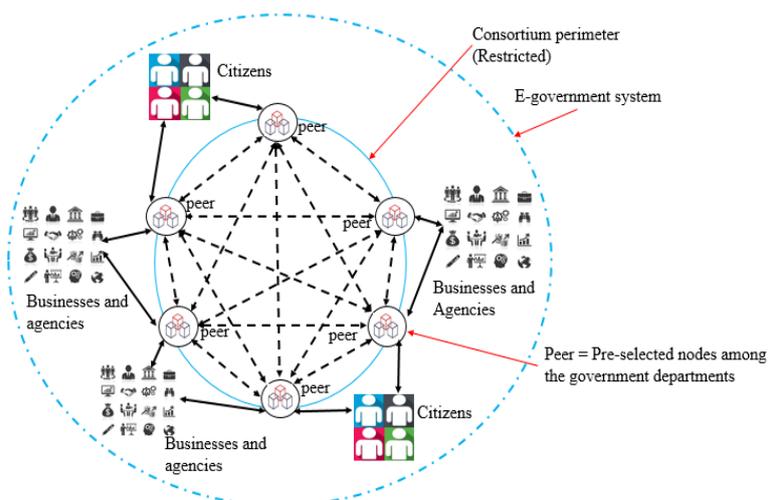


Figure 3: The consortium blockchain-based e-government network.

Network Layer

The main function provided by the network layer is the connectivity between e-government users, government consortium blockchain layer and the ledger storage servers. There is a wide choice of technologies that can be used on this layer such as WiFi, Ethernet LAN or cellular network. The participants of the consortium blockchain will use this layer to communicate transactions to/from the users and store new blocks in the ledger storage layer. Wireless communication provided by this layer will be used to support wireless devices whilst interacting with the e-government consortium blockchain network, because many governments around the globe are trying to incorporate wireless broadband networks across different cities using WiFi technology due to its great flexibility and convenience (Wireless Broadband, 2018).

Ledger Storage Layer

This layer is introduced in order to enable storage and replication of government and users data. This layer will be used to store off-chain (sideDB) data such as pictures, contracts, PDFs, and other files that are too large to be stored in the blockchain or that are required to be deleted or changed in the future. The blockchain database is append-only and immutable; so they cannot be deleted in the future. This layer is so critical in case that data reuse is required as the data that are store in the blockchain network are immutable and difficult to be reused. The off-chain storage of data is required for documentation and verification in blockchain technology (Cachin, 2016). A hash value for the off-chain document will be produced and stored in the consortium blockchain ledger whilst the real document is stored in the ledger storage layer. Additionally, the data that are processed by the participants of the consortium blockchain will be replicated and stored in this layer to allow more storage spaces for the blockchain network devices.

PERFORMANCE EVALUATION

A detailed technical analysis on the performance of the consortium blockchain is reported in (Dib et al., 2018), which helps organisations to evaluate the system before its adoption. The same performance measures, including the single transaction time and the number of transactions validated per second, were also utilised in this work, to evaluate the proposed consortium blockchain-based e-government system. All technical evaluations were performed by using the Ethermint protocol of Ethereum blockchain which support smart contracts over consortium network (Dib et al., 2018).

Performance Based On The Number Of Transactions Per Second

The performance of the consortium blockchain network based on the number of transactions processed per second with increasing number of validators in the network, is illustrated in Figure 4. Note that, the ideal case happens when all transactions from the users are validated in one second or less. It is clear from the figure that, the number of average transactions validated per second decreases as the number of validators increases in the consortium blockchain network. This is because the communication overhead required to pre-vote for a node will process the transactions, create a block, and append it to the ledger. Thus, if a given consortium blockchain system requires a large number of validators, the transaction processing speed will decrease. In e-government systems, this may not be the case since all participating department save the same goal of proving public services, fewer validators is usually enough and trusted to process and validate transactions.

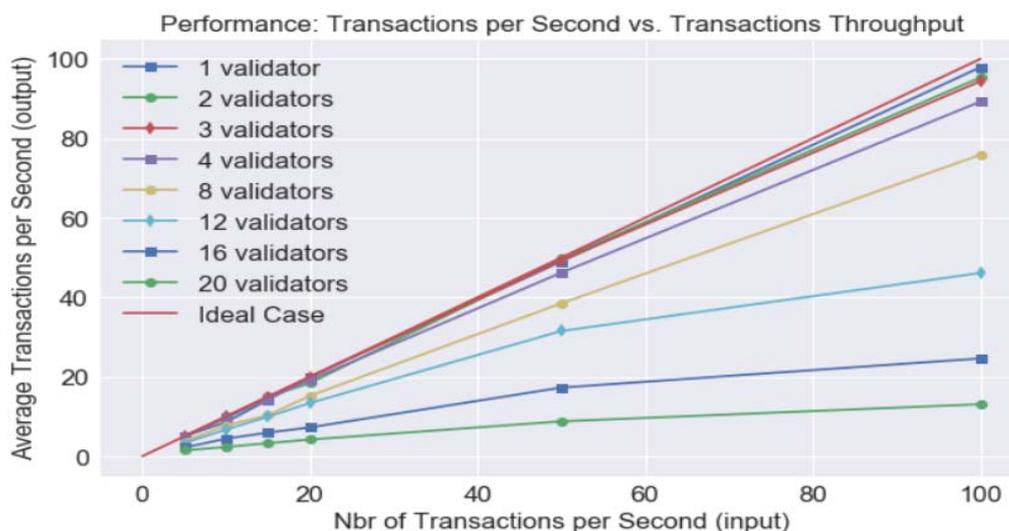


Figure 4: The number of transactions per second against validators.

From this figure, a consortium network with 1, 2, 3 or 4 validators can validate 100 transactions in a few seconds, which is close to the ideal case. However, for a consortium network comprised of 8, 12, 16 or 20 validators, the network requires several seconds to validate 100 transactions, which deviates far from the ideal situation.

Performance Based On The Validation Time

More time is required to validate a transaction as the number of validators increases in the consortium blockchain network, as shown in Figure 5. If a consortium network contains one validator, the average validation time is lower (less than 1 sec), however, validation time increases to almost 2 minutes when a network contains 20 validators in the experimental environment. Apparently, a compromise needs to be made between the desired network performance, the number of transactions sent per second, and the number of validating peers in a consortium blockchain network, which should be fully considered during the design stage. More specifically, an extra care must be taken to select the appropriate number of validators in the consortium network for a balance between security and transaction throughput.

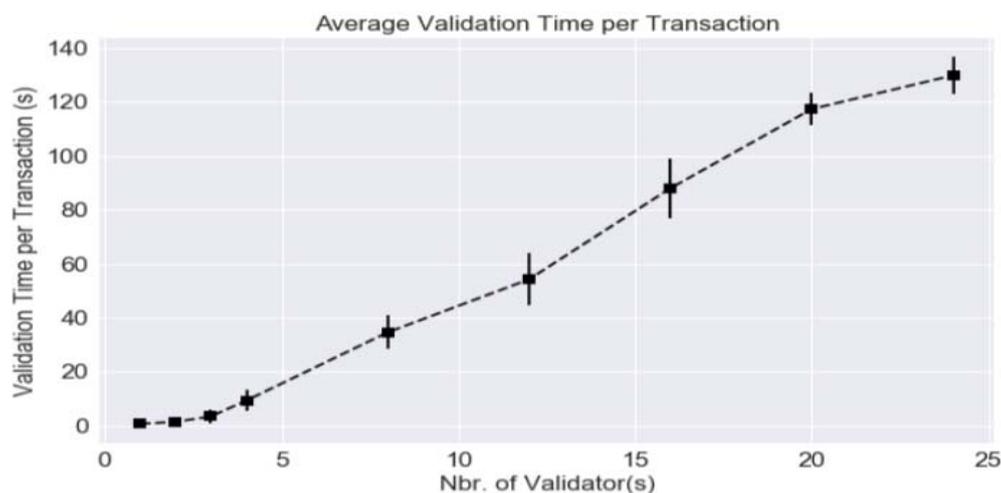


Figure 5: Validation time against the number of Validators.

Evaluation On Security And Privacy

This section presents a qualitative evaluation on how the proposed consortium blockchain-based system can prevent common threats to security and privacy in e-government systems.

Prevention against distributed denial of service (DDoS) attacks – Usually occur when attackers flood online services with massive traffic with fake requests in order to render the service unavailable. Generally, DDoS attacks tend to consume a significant amount of bandwidth and resources until the service is down. In the proposed consortium blockchain-based system, no centralised server that can be a direct target for DDoS attacks. The decentralised nature of the proposed consortium blockchain will allocate data and bandwidth to the less overloaded peers in the network to absorb DDoS attacks when it happens.

Authentication and authorisation attacks – This may occur when the adversarial users try to take control of the consortium blockchain network so that they can authorise themselves or introduce fake nodes for authorising users whilst taking control of the network. This is impossible in the proposed system since all peers of the consortium network are pre-selected by an authorised entities from an e-government agency of a particular government beforehand.

Threats to anonymity – Anonymity in blockchain-based applications may open the door for criminals to carry out unauthorised activities (Elisa et al., 2018b). In the proposed system, the blockchain information is only available to the consortium peers and authorised users. Therefore, any adversary trying to set up an anonymous connection will be detected instantly since the validators verify all users who attempt to access to the information stored in the consortium network. The advantages of the proposed e-government consortium blockchain are summarised in Table 1.

Table 1: Advantages of the consortium blockchain-based e-government network.

Advantage	Description(s)
Fast transaction speed	Only a selected group of participants process transactions.
High scalability	New participants can be added to a controlled number of consortium nodes when needed.
Low transaction costs	The transactions validators process transaction without incentives like in public blockchain.
Low energy consumption	A voting mechanism is used to pre-select the validating nodes, no computation is needed.
Low risk of 51% security attack	Random participants are not allowed to join the consortium unlike in public blockchain.
High transparency	Participants of the network know their peers within the consortium (more of enterprise).
High data integrity	Information is maintained in a consistent manner within the consortium network.
High collaboration	Different department and agencies will be able to share information on demand.

CONCLUSION

This work proposes a secure and privacy-preserving e-government architecture based on consortium blockchain technology for effective information sharing. The performance evaluation on a single transaction time, the number of transactions per second, and the number of validators has shown that, the consortium blockchain can be adopted in e-government systems by carefully keeping fewer number of validators in the network. Additionally, the proposed architecture can offer advantages such as high scalability, high transaction speed, high data integrity, high collaboration, low risk of 51% security attack, low energy consumption, low transaction cost and anonymity, whilst simultaneously ensuring the required level of security and privacy in e-government systems. The active future work is to use Cyber-Defense Technology Experimental Research Laboratory (DETERLab) test bed environment to evaluate the proposed consortium blockchain-based e-government system for real time attacks.

ACKNOWLEDGMENT

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Constructing an emergency intelligence system: A multi-level framework

(Full Paper)

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ABSTRACT

The processes and patterns of actors participating in emergency intelligence activities are not transcendental; instead, they are gradually molded in the intelligence activities and their corresponding management activities. The article constructs the emergency intelligence system based on the macro, meso and micro interconnected multiple mutual-construction theory. The research illustrates the constitution relations between the different levels of the emergency intelligence system and the interactions between the elements of the intelligence system. It also focuses on the analysis of the operating mechanism and the multi-level framework of the emergency intelligence system.

Keywords: Intelligence system, constructivism, activity theory, structuration theory, actor structure, multiple mutual-construction

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INTRODUCTION

The modern society is built on the cyber space (John-Green & Watson, 2014), and the popularization of Internet of Things and Internet has enabled every object and every individual to connect to the network and become an information producer. Intelligence is no longer considered to be a mysterious thing (Saavedra, 2015). New changes in intelligence gathering and analysis emerging in this century need to arouse the attention of researchers, and significant changes will take place in the application scenario and operation methods of the future intelligence system. Intelligence services based on large scale and heterogeneous data resources have been applied in areas such as library and information retrieval and international comparative research (Light, Polley, & Boerner, 2014; UK Government, 2016). Facing new business areas, such as emergency management, the existing theoretical paradigm and system design methods are out of step with the openness, globalization and networking of the modern society. Both the academic and industrial circles mostly view the intelligence and intelligence system from the perspective of technology, overemphasizing the supporting factor of information technology, with little consideration of the issues from the angle of the social existing significance of intelligence. Some researchers have noticed that the designers and users of existing intelligence systems pay attention only to the performance characteristics, such as the target detection and the probability of false reporting (Pakhomov, 2010), or the scale and form of information, instead of the final effect of use, which is obviously away from the social reality and the real needs in applications.

The intelligence service oriented to emergency management has important realistic social significance. The emergency management is considered to be the process by which an organization deals with a sudden, major, unpredictable event that threatens to harm the whole organization or the whole society (Aldewereld et al., 2011). Traditional emergency management is organized from a functional perspective and operates according to a hierarchical and centralized structure (Hutchins et al., 2002; Diedrich et al., 2002). The priori roles and processes allocated are passively responsive to changing demands (Bigley & Roberts, 2001; Jobidon, Turcotte, & Aubé, 2017). The intelligence systems and intelligence service processes that serve emergency management are also in this way. With the reinvention of political balance, the development of emerging technologies, and the growth and flow of population, we are entering a new world. Risks are shifting from localization to the dependence of globalization (Topper & Lagadec, 2013), and managers' perceptions of risk shift from uncertainty to ignorance. Modern society has accumulated a great deal of knowledge and experience, but the supporting effect of the intelligence system on emergency management and the results of emergency response have always been unsatisfactory: On the one hand, the existing theories and methods cannot completely solve the complex problems of intelligence supporting for emergency management, as it is not only a technical problem, but more related to epistemology. On the other hand, the literature on information system strategy tends to focus on high-level (meso and macro) process analysis while ignoring organizational practices (Marabelli & Galliers, 2017), and lacks in the theoretical combination at macro, meso and micro levels. We therefore need an effective and systematic perspective and method to research, design and analyze emergency intelligence systems (Foglia, Greppib, & Guida, 2017), and extend their applications to information systems with similar characteristics.

DESIGN AND ANALYSIS OF EMERGENCY INTELLIGENCE SYSTEM

Research Paradigm through Society

The failure of intelligence support model and intelligence service mechanism is only the appearance of the problem, and the basic reason can be found from the intelligence research paradigm. Because of the following three reasons, not only the

problems faced by emergency intelligence service become uncertain, but also the emergency decision-making problems served by intelligence cannot be called certain: 1) the emergence of a large number of unconventional emergencies; 2) emergencies are parts of larger processes, rather than discrete events; 3) from the tight coupling of causality model to mutual influence and interaction. When users cannot definitely cognize problems, environment and their own needs, new research paradigms need to be adopted to adapt to high uncertainty. The structuration theory proposed by Giddens believes that people are social actors with reflexive and agency. As an integral part of society, the organization is no exception. Reflexive and agency link the individuals, organizations and society as a whole, forming a holistic construction oriented by management activities and through society, which becomes the starting point to research emergency intelligence system from the perspective of constructivism.

The Adaptive Structuration Theory (Desanctis and Poole, 1994) and the Duality of Technology Theory (Orlikowski, 1992) derived from Structuration theory have been widely used in the field of information technology. Desanctis and Poole combine causality and factors of social constructivism in a common model, to clarify and develop the structural capability of group decision-making interaction process. The focus of research and interpretation is on the process by which organizations incorporate information technology into their work and how they realize and restructure the information technology. The rules, resources and environment used by model are confined by organizational boundary and are deterministic. The practice lens account put forth by Orlikowski is built on the premise that technology structures are emergent and cannot be embodied into the design. While all human practice is embedded in a structured historicity, the intentional part is not structured, but being structured and will be structured. The existing theories have been very effective in analyzing the key success factors of information system projects and studying the adaptive behavior after the technology is adopted, but there are limitations to the research on the parts that are being structured and will be structured. For emergency intelligence system, we need to proceed from the top perspective of society and the bottom perspective of the actors at the same time, to make new exploration in a wider range of multiple mutual-construction relationships, and to pay more attention to being structured and going to be structured.

Hierarchical Model of Emergency Intelligence System

The construction of emergency intelligence system is a continuous process that takes place in the organizational network and social environment, and interacts at different levels. There are multiple elements in the system, they restrict and influence each other at micro, meso and macro level of structures, and together constitute the emergency intelligence system. Research on intelligence system should not only observe and reflect the practice activities of subjects on objects, constructing the system from the whole, but also avoid ignoring the interactions between subjects. It is necessary to analyze the contribution made by the interaction between individuals to the society content and management activities.

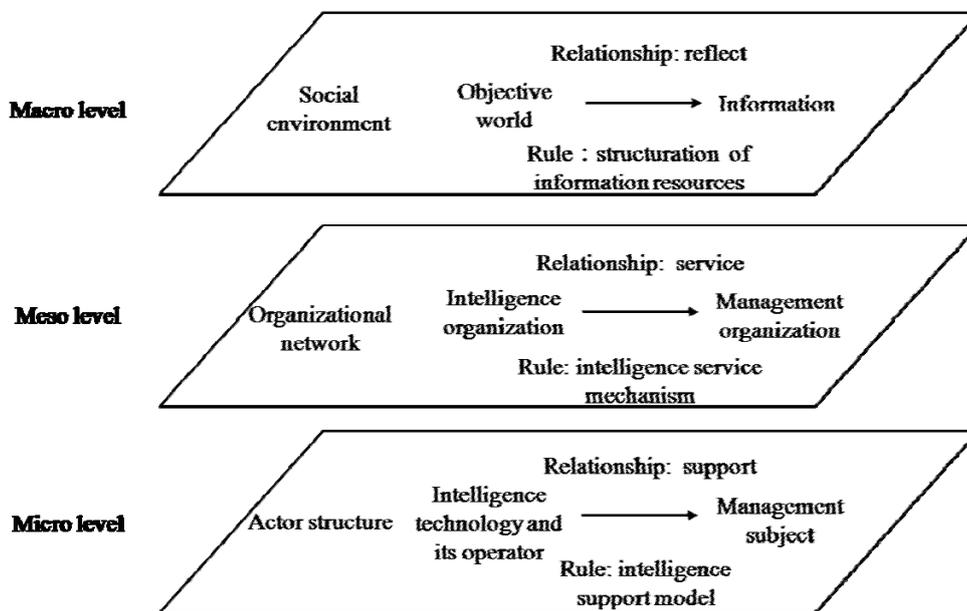


Figure 1: Hierarchical research model of emergency intelligence system

As shown in Figure 1, the elements of emergency intelligence system can be divided into resource elements and rule elements. Resource elements directly involved in the process of intelligence activities include management subject, intelligence technology and its operator, information and intelligence. Rule elements include structuration of information resources, intelligence service mechanism and intelligence support model. In emergency management, the intelligence system does not serve the solidified business process within the management organization; instead, it serves the emergency decision-making and its social consequences. Therefore, we cannot emphasize only the dual mutual-construction relationship between management organization and intelligence technology. There are multiple structures here: the consequences resulted from

intelligence – decision-making – management activities have an impact on the social environment, and in turn affect the intelligence and decision-making itself. The resource elements such as management subject, intelligence technology and its operator, information and intelligence cannot be piled up as intelligence system itself. There are multiple mutual-construction relationships between the actor structure, organizational network and social environment in the emergency intelligence system. Research on the emergency intelligence system needs to start from the intermediate elements between people and society, especially the rules elements that bridge other elements together.

Rule Elements of Emergency Intelligence System

Structuration of information resources

Information is one of the resource elements of emergency intelligence system, and the structuration of information resources is the rule element that bridges social environment and intelligence technology. Management subject hopes that through the planning and preparation of information resources, the information boundary and the information itself will be determined or approached to a definite form. However, this desire is facing the dual challenges of the complexity of social environment and the richness and complexity of the information it brings: In the context of the complexity of social environment, information and its sources have heterogeneous and complex characteristics, and information resources have become an open system that lacks overall consistency and is difficult to manage and plan. Because 1) information utilization is dependent on the structure of information resources; 2) faced with different services, the effectiveness of information resources structure is different; 3) the structure of information resources is dynamically changing, so it is only when the specific management activities and corresponding intelligence activities are carried out that the structuration of information resources can be temporarily established. The structuration of information resources is the depiction and construction of space slices of a social environment corresponding to a specific business at a certain time in the future, so as to adapt to the ability of the actor and promote the achievement of management objectives. With respect to emergency management, only when emergency decision-making and emergency response occur, in the determined activity space and time segment, the management subject, management content and organizational network can be confirmed, the structuration of information resources can be established, and the value of information can be reflected. This is a temporary organizational activity, not a fixed and pre-set digital activity, and its ultimate goal is to support decision-making rather than to stack data.

Intelligence service mechanism

The operation of emergency intelligence system originates from the structuration of information resources oriented to emergency management, and ends in the intelligence service for the decision-making subjects. The construction of emergency information system is a construction with the intelligence users and application environment as the center, instead of one with intelligence technology as the center. Viewed in the angle of intelligence users, the three sectors respectively formed in the political and state area, market economy area and citizen society area, i.e. the power organizations represented by governmental agencies, the market organizations represented by profit-seeking enterprises and social organizations represented by public welfare non-governmental organizations, form the framework foundation for emergency management operation jointly with residents in cities and rural areas, and jointly participate in management in the forms of permanent or temporary, formal or informal networks. The intelligence demands occurring in emergency management activities are characterized by diversification and correlation, including not only the diversified demands of management subjects of different types on intelligence contents and forms, but also the coordinated demands for intelligence by managers with associated or conflicting interests in the management of the same emergency, as well as the coordinated demands for intelligence in associated or potentially associated emergencies. Therefore, the emergency intelligence system needs to provide service to administrators in a complex and heterogeneous environment with fuzzy boundaries, and the intelligence service mechanism for emergency management needs to adapt to such situations, to promote the mutual collaboration of various parts and adapt to the rapidly changing social environment. When the new intelligence service mechanism is in operation, the space-time structure of the distribution of information resources changes in a beneficial way, and information resources will produce the agglomeration effect oriented to emergency management.

Intelligence support model

The activity of intelligence supporting decision-making is a two-way interactive process. This two-way feedback mechanism is called reflexivity. Reflexivity infuses each other with uncertainty, leading to the possibility that management behavior may produce unpredictable results. The ultimate deadlock in modern society consists in the gulf between knowledge and decision-making: no one really knows the consequences of the overall situation -- but we still have to make a decision. Decision-making is fallible, and even all contrived construction may be flawed. Reflectivity and fallibility are not the only source of uncertainty, but when we exclude technical conditions, they become the most important source of uncertainty in emergencies. The construction of emergency intelligence system needs to consider the factors of reflectivity and fallibility: 1) using fallibility and reflectivity to mitigate the impact of uncertainty; 2) using continuous and high-frequency decision-making to support the emergency decision-making in the context of fallibility; 3) adopting widely distributed sensing systems that support heterogeneous network to support emergency decision-making in the context of reflectivity.

Multi-level Analysis of Emergency Intelligence System

Jones and Karsten (2008) pointed out that researchers need to shift from the traditional focus on phenomena associated with information systems at the individual, group, and organizational levels to a wider range of research. As mentioned earlier, the relevant conceptual framework of emergency intelligence system includes multiple levels of close interconnection and

interaction: actor structure, organizational network and social environment. With reference to the viewpoint of Pozzebbon (2012), we place the multilevel framework within a constructivist tradition, and view the research of emergency intelligence system as procedural and inherently multilevel. There are many factors at each level, and there are interactions between factors within each level and among different levels of factors, which in turn influence the behavior of actors.

Morgeson and Hofmann (1999) have suggested identifying and integrating the unity between different levels with the functional similarity: a structure theorized as multi-level has function of equivalent relation at each level, therefore functions with similar structure (but different in structure) can be constructed as a wider network structure. But obviously, the multi-level framework of emergency intelligence system is not a multi-level structure with consistent functionality, and it even has no consistent directionality, that is, there is no hierarchical feature of decomposing from high to low or converging from low to high between levels, and it is multiple mutual-constructed, rather than being constructed in a single direction from society – organization – actors. In this framework, it is not always possible to find consistent relations between independent variables and dependent variables at different levels, and it is also difficult to seek for determined relation between different variables across levels. The multi-level analysis of emergency intelligence system is not for researchers of organization science to consider the method of construction at a higher level of analysis, instead, it provides for interdisciplinary researchers a holistic perspective to observe the mutual-construction relationship between social environment, organizational network and actors structure, as well as the mechanism and process of their joint action on the emergency management.

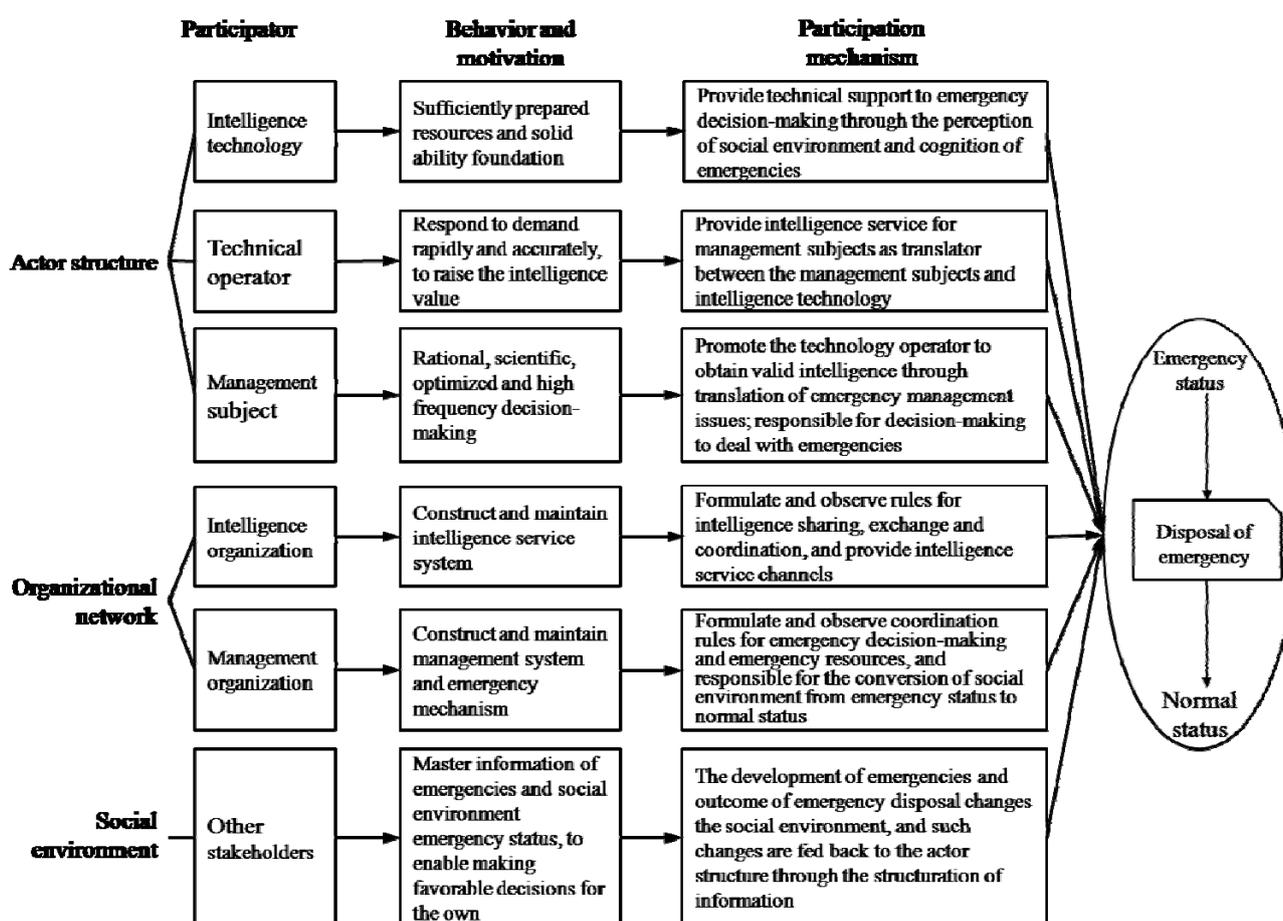


Figure 4: Mechanism of emergency intelligence system acting on the response of emergencies

CONCLUSIONS

When the human society becomes more and more abundant and developed, a variety of suspense is produced for the prospect of the world. People cannot predict the future accurately, and can only use scenario simulation and conceptions to imagine various possibilities of the future. This has forced the emergency managers to depend more and more on the experience, models and data involuntarily. However, in a modern society full of reflexivity, we are unable to understand at present and hard to judge in the future the future-oriented risks triggered by the management behavior resulted from emergency decision-making, so the traditional intelligence research paradigm has limitation in new social environment and emergency management activities.

This research is conceptual and theoretical. Starting from the perspective of constructivism, the theories, concepts as well as the new parts of different disciplines are integrated into a multidimensional framework to solve the theoretical problems in the

construction of emergency intelligence system. This theoretical framework and research paradigm can also be extended to apply to intelligence systems with similar characteristics. This article analyzes the challenges faced by emergency intelligence system and provides a holistic perspective on the construction of emergency management intelligence system. It closely integrates the macro (social environment), meso (organizational network) and micro (actor structure) levels of theories, explains the constitution relations between different levels and interactions between the intelligence system elements (resource elements and rules elements), and focuses on the analysis of operational mechanism and multiple mutual-construction relationships of emergency intelligence system. The emergency intelligence system is resource elements and constitution relations embedded into the social environment and organizational network, rather than a simple technical system: the management subjects, intelligence technology and its operator form a mutual-construction relationship at the micro level; the management subjects, intelligence technology and its operator, information resources and organizational network form a mutual-construction relationship at the meso level; the actor structure, organizational network and social environment form a mutual-construction relationship at the macro level. When we re-understand and construct emergency intelligence system using the research paradigm through society, the intelligence and intelligence system will become the foundation support and core assets of emergency management.

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Consumer brand post engagement on Facebook and Instagram – A study of three interior design brands

(Full paper)

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ABSTRACT

Social media has become an important part of consumers' brand interaction. This study takes a content analysis research approach in order to investigate the content type of three interior brands' postings on two popular social media sites, Facebook and Instagram, and explore how consumers engage with the content. The results show that slightly different content strategies are used on Facebook and Instagram, and the level of consumer brand post engagement varies between the two platforms. Instagram showed clearly a higher consumer brand post engagement compared to Facebook. Brand post engagement on the two social media sites is enhanced by entertaining and inspirational content. Especially on Instagram, inspirational content created the highest brand engagement. The findings are important for brands that strive to engage with fans on social media sites. Managerial and practical implications are discussed, together with future research.

Keywords: Social media, consumer engagement, online marketing, Internet research, social networks.

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INTRODUCTION

Social media marketing enhances customer engagement, creates brand awareness, allows for more targeted acquisitions of new customers and enhances promotions of products (Tsimonis & Dimitriadis, 2017; Sharma, Alavi & Ahujaa, 2017). Many brands have adopted social media to interact with their customers (He, Zha & Li, 2014). According to Tsimonis and Dimitriadis (2017), companies' activity in social media is primarily motivated by increased use by consumers, that competitors are present in social media, possible cost reductions in marketing activities, and that social media is part of companies' headquarter strategy. Many social media users want to, and do, follow brands on social media (Sprout Social Index, 2016). Virtual communities are also good places for passionate brand fans to meet (Hsu, 2019). However, following a brand does not directly correlate with brand engagement. Different types of brand messages generate different levels of consumer engagement in social media (De Vries, Gensler & Leeftang, 2012; Tafesse, 2015; Ge & Grezel, 2017). Little research has been conducted to investigate the challenge for companies to attract people's attention to brand posts and persuade them to engage with the content (Luarn, Lin & Chiu, 2015). There is, nevertheless, a growing research base on what type of posts drive consumers' engagement towards brands in social media (e.g. De Vries, Gensler & Leeftang, 2012; Tafesse, 2015; Ge & Grezel, 2017; Gutiérrez-Cillán, Camarero-Izquierdo & San José-Cabezudo, 2017; Menon *et al.*, 2019). Analyzing brand interaction in online communities from a consumer engagement perspective is interesting also from theoretical perspectives of consumer behavior and co-creative communities (Brodie *et al.*, 2013). Moreover, scientific research regarding consumers' brand post engagement on social media sites often seems to focus on Facebook fan pages (De Vries, Gensler & Leeftang, 2012; Tafesse, 2015; Ge & Grezel, 2017; Gutiérrez-Cillán, Camarero-Izquierdo & San José-Cabezudo, 2017; Luarn, Lin & Chiu, 2015; Schultz, 2017). However, companies have a need to monitor and analyze content on different social media sites (He, Zha & Li, 2014). Different social media sites have different posting features and possibilities for fans to engage with the brand (Virtanen, Björk & Sjöström, 2017). Likewise, different consumer engagement metrics are used on different social media sites (Coelho, de Oliveira & de Almeida, 2016). Hence, this study will focus on analyzing brand posts on two popular social media sites, namely Facebook and Instagram. Facebook is the most popular social network worldwide with 2234 million active users in October 2018 (Statista, 2018). Instagram had 1000 million active users at the same time period (Statista, 2018) and is gaining in popularity in the US, the UK and the Nordics (AudienceProject, 2017). Both platforms are actively used by consumers to follow brands online (AudienceProject, 2017).

According to previous studies there are several types of variables that impact consumer brand post engagement on social media sites. Cvijikj and Michahelles (2013) proposed posting time, media type and content type to effect Facebook engagement. Swani *et al.* (2017) suggested brand cue, message appeal, selling strategy, information search, company fan base and message time as impact factors on social media likes and comments. Ge and Grezel (2017) focused on humor in the posting message, along with message complexity and product focus. Tafesse (2015) in turn analyzed brand post vividness, interactivity, novelty, consistency and content types, and controlled the audience engagement with fan base, product category and posting date. In other words, there is an extensive number of variables that can explain brand post engagement of social media sites. In this

study the focus will be on content type. The argument for this decision is that content type has been found as an important driver for brand post engagement in previous studies (Ashley & Tuten, 2015; Tafesse, 2015; Coelho, de Oliveira & de Almeida, 2016; Schultz, 2017; Cvijikj & Michahelles, 2013; Kim, Spiller & Hettche, 2015).

The main objective in this study is to take an explorative consumer engagement approach to analyze three interior design brands' postings on Facebook and Instagram. Within interior design social media is actively used for marketing communications and the preferred social media sites for interior designers are Facebook and Instagram (Unity Marketing, 2018). Hence, interior design is an interesting branch to study for the purpose of this study. We conduct content analysis to identify the characteristic of the content that the three brands are posting on the two social media sites, and investigate differences in consumer brand post engagement regarding these postings. Knowledge about this topic contributes to the theoretical discussion on consumer engagement and to brands who seek to improve consumer interactions by using social media.

We will first conduct a literature review where the focus is on consumer engagement, metrics for measuring engagement and different content types in social media postings. Thereafter, we present the method, which includes the data collection, sample and variable operationalization and coding. Results are presented and discussed. Finally, we conclude with a summary of the study's contributions and directions for future research.

LITERATURE

Brand Post Engagement And Metrics

There are different theoretical perspectives to analyze engagement in social media, namely online advertising, brand community and uses and gratification theory (Tafesse, 2015). This study is based on literature regarding consumer engagement. The engagement concept has become increasingly used in marketing literature within the area of consumer behavior and co-creative communities (Brodie *et al.*, 2013). The conceptual roots of consumer engagement are derived from theory regarding interactive experience and value co-creation within relationship marketing and service-dominant logic (Brodie *et al.*, 2011). Social networks have changed the dynamics of marketing interchange between companies and consumers and in this new non-transactional environment the focus has shifted from transactions towards consumer engagement and participation (Cvijikj & Michahelles, 2013). Consumer engagement in a virtual brand community is dynamic and multidimensional in character, where engaged consumers display increased loyalty, satisfaction, empowerment, connection, emotional bonding, trust and commitment towards the brand (Brodie *et al.*, 2013). Hollebeek *et al.* (2014) propose that consumer brand engagement consists of three dimensions; (1) generic cognitive, (2) emotional and (3) behavioral. The cognitive dimension is defined as "a consumer's level of brand-related thought processing and elaboration in a particular consumer/brand interaction". The emotional dimension refers to "a consumer's degree of positive brand related affect in a particular consumer/brand interaction". The behavioral dimension is defined as "a consumer's level of energy, effort and time spent on a brand in a particular consumer/brand interaction". These dimensions, according to the authors, describe consumers' activities in brand interactions.

In this study we monitor the behavioral outcomes of consumer engagement with brand posts in social media. A similar approach to investigate consumer engagement on social media was used by Schultz (2017). On social media fans can interact with brand posts by pressing e.g. like, commenting on them or sharing them (Luarn, Lin & Chiu, 2015). The fan engagement levels on Facebook have been described as a pyramid where Like is at the bottom (the mildest level of engagement), Reaction is a form of emotion icons (e.g. Love, Sad), Commenting goes beyond Liking in engagement with a brand, sharing indicates trust towards a brand and on the top of the pyramid create represents Involvement, which goes beyond engagement (co-creation of content) (Sharma, Alavi & Ahujaa, 2017). Consumers' online brand-related activities have also been described as a path to gradual involvement with brands on social media; the first step is consumption (e.g. viewing and reading branded content), the second step is contributing (e.g. commenting on brand related content) and the third step is creating (e.g. uploading brand related content) (Muntinga, Moorman & Smit, 2011). Hence, it seems clear that consumer brand post engagement has different levels of involvement, which should be considered when selecting a measurement model or formula for measuring brand engagement. Consumer engagement also occurs within a specific situational context that generates different levels of engagement (Brodie *et al.*, 2011).

Different studies have used different approaches to measure social media engagement. De Vries *et al.* (2012) measured numbers of likes and comments, Tafesse (2015) measured number of likes and shares, Luarn, Lin and Chiu (2015) and He, Zha and Li (2014) measured number of likes, comments and shares. Ge and Grezel (2017) adapted a formula used by Unmetric.com to calculate the weighted customer engagement. The formula used was calculated as follows: Likes*1 + Comments*5 + Reposts*10. The weighted formula considers the different levels of brand post engagement as described above and thus we see it as a valuable approach to calculate engagement. According to Coelho, de Oliveira and de Almeida (2016) the primary engagement metrics for Facebook are likes, comments and shares, and for Instagram likes and comments. We will use the metrics proposed by Coelho, de Oliveira and de Almeida (2016) for our study, together with the weighted formula used by Ge and Grezel (2017), to measure consumer brand post engagement in this study.

Content Type And Engagement

Content in marketing communication strategies refers to the message that is transmitted (Mohr & Nevin, 1990). Content categorizations are based on the type of information that is exchanged and the type of influence message that is embedded in

the exchanged information (Mohr & Nevin, 1990). Good social media content is likely to trigger consumers to engage (Ashely & Tuten, 2015). Previous studies propose different types of brand posts typologies and categorizations of content in social media. For example, based on an extensive study of Twitter content the following content types were identified: information-sharing, emotion-evoking, and action-inducing content (Taecharungroj, 2017). The findings are, however, mixed as to whether the content type actually affects consumer engagement (Schultz, 2017). De Vries *et al.* (2012) did not find informational and entertaining content to have an impact on likes and comments in social media, while Luarn, Lin and Chiu (2015) found informational, entertainment, remuneration and social posts to be crucial elements in driving online engagement. Cvijikj and Michahelles (2013) also found entertaining content to drive liking, commenting and sharing on social media. On the other hand, De Vries *et al.* (2012) found that higher interactivity and vividness of posts showed a positive impact on the number of likes. Interactive posts were defined as contests to win prizes, questions, quizzes and calls to act (urge fans to respond), and high vividness was defined as announcements of upcoming brand events and videos. Tafesse (2015) in turn categorized content as transactional, informational and entertaining. In that study entertaining content showed positive effects on Facebook likes. Also, content novelty (post on new products, brand events, unique product displays) was found to have a positive effect on the number of likes and shares (Tafesse, 2015). Coelho, de Oliveira and de Almeida (2016) findings show that especially events and promotion related content led to higher engagement on Instagram and in a study by Schultz (2017) content with presentations of competitions showed high influence on the social media engagement (likes, comments, shares) and recruiting information showed high influence on likes and shares. There are also differences between different industries regarding consumer engagement with content in postings (Schultz, 2017; Kim, Spiller & Hettche, 2015). In the industrial service category, the self-oriented content (i.e. information about the company or its products, or company events and campaigns) was less liked than task- and interaction-oriented content, while in the consumer convince industry self-oriented content was liked and shared more than interaction-oriented content (Kim, Spiller & Hettche, 2015). Content on different types of social media site also generate different types and levels of consumer engagement (He, Zha & Li, 2014).

See Table 1 for a summary of some previous categorizations of social media content type and their effects on consumer engagement. As we can see from Table 1, there are clearly diverse classifications of content type in social media postings and differences in how content effects engagement. Based on this, we raise the following two research questions:

- What type of content are interior design brands posting on Facebook and Instagram?
- Are there differences in consumer brand post engagement regarding these postings?

Table 1: Content type and effect on engagement in previous studies

Study	Content type	Effect on engagement
De Vries, Gensler & Leeflang, 2012	<u>Informational</u> : information about the brand and/or its products. <u>Entertaining</u> : content unrelated to the brand e.g. funny movies or anecdotes.	No influence on likes and comments.
Luarn, Lin & Chiu, 2015	<u>Informational</u> : content about specific products, brands and related marketing activity. <u>Entertainment</u> : humorous videos, teasers, slogans and wordplay. <u>Remuneration</u> : promotions, coupons, special offers and other offers to attract attention. <u>Social posts</u> : questions and statements aimed to bring out interaction with users.	All categories showed positive effect on likes, comments and shares.
Tafesse, 2015	<u>Transactional</u> : price promotions, deals and other sales related details. <u>Informational</u> : product reviews, product recommendations and specifications. <u>Entertaining</u> : contests, events, humorous things.	Entertaining content affected Facebook likes positively.
Coelho, de Oliveira & de Almeida, 2016	<u>Advertising</u> : posts to promote brands and entertaining content. <u>Events</u> : photo and video media, directly connected to brands. <u>Fan</u> : the fan is responsible for the content or the idea. <u>Information</u> : Data about events, places, opportunities, people or celebrities, directly connected to a brand. <u>Promotion</u> : like quizzes, which promote participation of followers through rewards.	Events and promotions lead to higher engagement on Instagram.
Schultz, 2017	<u>Charity</u> : information on charity events. <u>Competition</u> : presentations of competitions. <u>Content</u> : informative post related to a product. <u>Coverage</u> : reports event such as photo shoots. <u>Holiday</u> : posts referring to holiday, season or weekend. <u>HR</u> : recruiting information. <u>Product</u> : post related to specific products. <u>Promotion</u> : discounts, sales or store openings.	Competitions showed high influence on likes, comments and shares. HR showed high influence on likes and shares.

	<u>Statement</u> : posts stating an opinion on a topic.	
Cvijikj & Michahelles, 2013	<u>Entertainment</u> : teasers, slogans, or word play, most of those explicitly asking for an engagement from fans. <u>Information</u> : traditional advertisement, thus containing information about specific products, brand, or the company. <u>Remuneration</u> : sweepstakes organized within the Facebook brand pages.	Entertainment was found to be the most influential, increasing liking, commenting and sharing.
Kim, Spiller & Hettche, 2015	<u>Task oriented contents</u> : persuasive messages, new product announcement, online discounts, coupons and contests. <u>Interaction oriented contents</u> : Content not directly related to the brand, celebrating a special day or asking to interact and answer questions <u>Self-oriented contents</u> : Information about the company or its products, or company events and campaigns.	Content type impact engagement dependent on industry type

Source: This study.

METHOD

Data Collection And Sample

This study employs content analysis to address the research questions. The three companies selected for data collection were chosen based on their high rankings in brandsome.fi, a Finnish site that ranks brands based on their popularity. Popularity on brandsome.fi is the number of followers in the following social media sites; Facebook, Twitter, Instagram, YouTube and Pinterest. The pick was made week 16/2017 within the interior design store (sisustusliike in Finnish) category on brandsome.fi. Hence, all three companies (referred to here as brand A, B and C) are Finnish brands that can be categorized as interior design brands. All three companies are small-medium size enterprises regarding number of employees and turnover.

All public brand posts published in Facebook and Instagram between October 2016 and March 2017 for all three brands were collected manually. One researcher functioned as the collector and coder of the raw data used for this study. By manually looking at each post during data collection, a better understanding of the visual intent of the posts should be achieved, as opposed to an automatic procedure with a software program (Laestadius, 2017). All information was gathered without logging into either a Facebook or Instagram account during the data collection, as suggested by Laestadius (2017). Logging in may result in inclusion of data from private accounts (Laestadius, 2017).

The sample was collected between April 1st and 26th 2017. The number of likes, comments and shares change continuously in social media; or posts may be managed, made private, or deleted by users after being collated. A final update was made April 30th 2017 and hence the numbers presented in the results are representative of the situation on April 30th 2017. Laestadius (2017) recommend allowing sufficient time for users to reflect on posted content after it has been published. Data collection one month after the last post ought to be sufficient, as most reactions are often received within the first 48 hours. Overall, the sample size was 392 Facebook posts and 388 Instagram posts, which makes a total of 780 posts.

Operationalization And Coding

To operationalize the type of content in the posts we used the content types of previous studies as a base, as described earlier in Table 1. In the initial coding process a textual description of the main message in every post was registered, along with data on product visibility in the message, and whether the content was shared or not. By analyzing the descriptions of the posts, we discovered other types or nuances of content that did not fit directly into previous categorizations. Hence, we partly adopted an inductive approach to code the content categories. We coded transactional and entertaining content as described in Tafesse (2015) but re-labeled informational as inspirational content. An inspirational approach to present product related content seems to be typical for interior design brands, where the postings strongly aim at evoking emotions and design ideas regarding the products, patterns and different product related settings. A similar category of emotion-evoking content has also been identified by Taecharungroj (2017). Cooperative was added, as a substantial part of the content in the posts was shared or co-produced content with bloggers, stylists, magazines, TV-shows etc. A similar type where the fan was behind the idea and content of the post was used by Coelho, de Oliveira and de Almeida (2016). Also Taecharungroj (2017) identified content-sharing as an important social media communication strategy by a global brand. A fifth type, miscellaneous, was added as some content could not be fitted into any of the other types. This content was typically general announcements and updates. See Table 2 for a description of the five content types used in this study. The final coding of content types was conducted by the principal researcher based on the description of each collected posting.

Different emotional icons (emoji's) in Facebook related to like/dislike/heart were not separated, therefore "likes" include all these reactions. Although the use of emoji was mainly positive towards the brands, some likes may in fact be negative reactions towards brand posts. Hence, we are here mainly measuring the behavioral dimension of engagement, rather than the emotional dimension (Hollebeek *et al.*, 2014). The number of comments and shares were also collected from the brands' Facebook fan pages and comments from the brands' Instagram fan pages. In Instagram, shares are not shown in a similar manner to that of Facebook posts. In Instagram, content is basically shared by tagging other people, or the post is reposted to the person's own account. Also, Coelho, de Oliveira and de Almeida (2016) suggested to use likes and comments in Instagram. To calculate the weighted consumer brand post engagement on both platforms, we used the formula adapted from

Unmetric.com by Ge and Grezel (2017). The formula used was calculated as follows: Facebook engagement = 1*Likes + 5*Comments + 10*Shares and Instagram engagement = 1*Likes + 5*Comments.

The coding also included posting time according to the six months investigated (October to March), the social media site (Facebook, Instagram) and brand page coded according to the three companies (A, B and C) investigated. The follower base of the three brands was also registered at the final sample update.

Table 2: Content type

Content type	Description
Inspirational	Inspirational product and pattern picks, new product arrivals and other inspirational product related calls to act (e.g. take a look at this, get inspired).
Entertaining	Contests for prizes, fun events and questions for fans.
Transactional	Price promotions, deals and other sales related details.
Cooperative	Shared or co-produced content with bloggers, stylists, magazines, TV-shows etc.
Miscellaneous	Content which does not fit into any of the other characteristics (e.g. general announcements and updates).

Statistical Analysis

All statistical analysis were conducted in IBM SPSS Statistics 25. Preliminary analysis were conducted to check normality distributions and homogeneity of variance between groups. The main analysis included descriptive statistics of brand postings and content type, and a four-way ANOVA-analysis and an one-way ANOVA-analysis with post hoc tests to understand brand post engagement. An ANOVA-analysis was chosen as the dependent variable is continuous and the independent variables are categorical.

RESULTS

Brand Postings and Content Type

In Table 3 we can see that Brand A was the most active in posting content of the three brands with 146 posts in Facebook and 166 posts in Instagram. Brand B was the only brand to publish more posts in Facebook than in Instagram – on average 22 posts per month in Facebook and 14 posts per month in Instagram. Brand C posted on average 19 posts per month in Facebook and 24 in Instagram. By summing up the mean number of posts per week for all three brands, five posts was the mean both on Facebook and Instagram. Overall, November to December before Christmas was the peak period for postings on both platform (Table 3). Of the total 388 Instagram posts, 156 (40.2%) were made during this period. Similarly, out of 392 Facebook posts, 147 (37.5%) were posted in November to December. Also, other festivities (e.g., Halloween, Finnish Independence Day, Valentine's Day, and Father's day) generated peaks in frequency of postings. All three brands have a larger follower base on Facebook. The average follower base of the three brands, as of the final sample update, was 31048 followers on Facebook and 17300 followers on Instagram (Table 3).

Table 3: Number of postings, posting time and followers

Brand page	Postings			Posting time						Followers	
	Total	Facebook	Instagram	Oct	Nov	Dec	Jan	Feb	Mar	Facebook	Instagram
A	312	146	166	51	54	64	50	36	57	16486	13300
B	212	130	82	27	42	54	35	26	28	32146	21800
C	256	116	140	48	53	37	39	35	44	44510	16800
Total	780	392	388	126	149	155	124	97	129	93142	51900
Average	260	131	129	42	50	52	41	32	43	31048	17300

Table 4 shows the postings according to content type. Most of the posts on both sites were of inspirational character. Overall, Instagram received more inspirational posts than Facebook. Facebook in turn received more transactional and miscellaneous posts than Instagram. Entertaining and cooperative content gained quite similar numbers of posts on both social media sites. A chi-square test for independence indicate a significant association between social media site and content type, $\chi^2(4, n = 780) = 43.107, p < 0.001$.

Table 4: Posting according to content type

Content type	Total posts	N = 780 %	Facebook posts	N = 392 %	Instagram posts	N = 388 %
Inspirational	450	57.7	194	49.5	256	66.0
Entertaining	20	2.6	11	2.8	9	2.3
Transactional	150	19.2	91	23.2	59	15.2
Cooperative	118	15.1	58	14.8	60	15.5
Miscellaneous	42	5.4	38	9.7	4	1.0

Consumer Brand Post Engagement

In Table 5 we can see the mean score of Likes, Comments and Shares per post on the two sites, followed by the weighted engagement (WE) mean score. In Table 6 we can see the descriptive statistics of weighted engagement according to content type overall and for both Facebook and Instagram. Based on the numbers in Table 5 we can see that Instagram gained overall higher consumer brand post engagement, despite that shares are excluded from the Instagram score. The main difference between Facebook and Instagram seems to be the mean number of Likes. We also divided the WE number with the average number of Facebook and Instagram followers of the brands. Instagram scores a higher follower engagement rate 2.72% (WE 469.89 / Followers 17300) than Facebook 1.01% (WE 304.17 / Followers 31048).

Table 5. Descriptive statistics of consumer brand post engagement

	Facebook Mean	SD	Min	Max	Instagram Mean	SD	Min	Max
Brand post likes	235.71	265.86	2	1751	460.64	269.54	72	1923
Brand post comments	10.83	96.61	0	1706	1.85	2.17	0	15
Brand post shares	2.86	9.40	0	102	-	-	-	-
Brand post WE*	304.17	633.03	2	10037	469.89	272.98	72	1963

* Likes*1 + Comments*5 + Shares*10

Table 6. Descriptive statistics of weighted engagement (WE) according to content type

Content type	Overall WE			Facebook WE			Instagram WE		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Inspirational	450	421.45	361.14	194	299.00	318.60	256	514.24	296.26
Entertaining	20	1121.20	2224.37	11	1718.91	2723.47	9	412.89	177.55
Transactional	150	311.35	342.36	91	264.62	336.73	59	383.44	227.08
Cooperative	118	289.60	202.91	58	185.92	232.97	60	389.81	165.09
Miscellaneous	42	200.00	153.93	38	196.21	159.43	4	236.00	98.60
Total	780	386.60	495.00	392	304.17	633.03	388	469.89	272.98

In order to further analyze the data, we explored the normality distribution of the weighted engagement. The engagement was heavily positively skewed. The skewness coefficient was 10.741 and kurtosis 190.25. Hence, we did a logarithmic transformation of the weighted engagement to exclude unusual cases. Similar transformations have also been conducted in other social media engagement studies with positive skewness (Kim, Spiller & Hettche, 2015). The transformed engagement variable improved to a skewness coefficient of -0.957 and kurtosis of 2.174. We used the transformed engagement variable as dependent variable in an ANOVA-analysis to test the main and interaction effects of content type and social media site (Facebook vs. Instagram). To control for the possible main effects of the number of postings and follower base of the three brands and the time of postings, the variables brand page and posting time were included as additional independent factors in the analysis. We also tested the homogeneity of variance. The Levene's test of equality of error variances was significant (22.601, $df_1/df_2 = 9/770$, $p < 0.001$), thus we should set a more stringent significance level (at least 0.01) when analyzing the effect sizes of the model (Pallant, 2016).

The ANOVA-analysis does confirm the type of social media site to have a main effect on the weighted engagement (Table 7). There is also a clear interaction effect between type of social media site and content type on WE. Furthermore, the result shows a strong significant main effect of content type on engagement. Hence, our further analysis includes a one-way ANOVA with post hoc test to better understand the differences between content type on Facebook and Instagram (see below). It should be noted that the control variable brand page had a significant effect on engagement but posting time did not show significant effect. The results in Table 7 show that the model explains 30.0% of the variance (adjusted R² squared), thus it is obvious that there are other variables that also affect consumer brand post engagement.

We ran a one-way ANOVA with post hoc test to investigate differences in the logarithmic weighted engagement between the five content types for the total sample and for the Facebook and Instagram data separately (Table 8). The Levene's test of homogeneity of variance was significant for the overall data (9.973, $df_1/df_2 = 4/775$, $p < 0.001$) and the Facebook data (5.030, $df_1/df_2 = 4/387$, $p = 0.001$), but not for the Instagram data (1.550, $df_1/df_2 = 4/383$, $p = 0.187$). Hence, we used (as suggested by Pallant (2016)) the Welch-test for the overall data (15.000, $df = 4$, $p < 0.001$) and Facebook data (5.905, $df = 4$, $p < 0.001$), but the F-test for Instagram data (7.555, $df = 4$, $p < 0.001$). All three tests were clearly significant. Then we used the Games-Howell post hoc for the overall data and the Facebook data, and the Tukey post hoc test for the Instagram data. The Games-Howell post hoc test is suitable when unequal group variances are assumed and there are unequal group sizes, and the Tukey post hoc test is suitable when equal variances are assumed but there are unequal group sizes (Shingala & Rajyaguru, 2015).

In Table 6 we can see that entertaining content clearly scores the highest mean value overall, and the pairwise comparisons with the Games-Howell post hoc test does show a significant difference between entertaining content and transactional, cooperative and miscellaneous content (Table 8). In addition, inspirational content does overall show a clear positive mean difference towards transactional, cooperative and miscellaneous content.

The number of cases for Entertaining content (9 cases) and Miscellaneous content (4 cases) on Instagram is low, thus these two content categories were omitted from the Instagram ANOVA-analysis. On Instagram, inspirational content received the highest mean score. The Tukey post hoc test confirms a significant difference between inspirational content and transactional and cooperative content (Table 8). Also, on Facebook inspirational content scored a significantly higher mean than transactional and cooperative content. Entertaining content scores the clearly highest mean value on Facebook, but due to the low number of cases (11) the results need to be omitted from the ANOVA-analysis. When we analyzed the Facebook engagement numbers in detail, we found a few prize competition posts (categorized as entertaining content) that acquired very high engagement numbers. Therefore, it seems that some highly attractive prize competitions generate peaks in engagement on Facebook.

Table 7. ANOVA-analysis for the dependent Log (weighted engagement)

Effect	Type III Sum of Squares	df	Mean Square	F	p	Partial η^2
Corrected Model	257.406	16	16.088	21.823	0.000	0.314
Intercept	5383.047	1	5383.047	7301.864	0.000	0.905
Content type	31.172	4	7.793	10.571	0.000	0.053*
Social media site	21.010	1	21.010	28.498	0.000	0.036*
Brand page	18.333	2	9.167	12.434	0.000	0.032*
Posting time	5.559	5	1.112	1.508	0.185	0.010
Content type * Social media site	14.953	4	3.738	5.071	0.000	0.026*
Error	562.495	763	0.737			
Total	24632.028	780				
Corrected Total	819.902	779				

a. R Squared = 0.314 (Adjusted R Squared = 0.300), * The effect size is significant at 0.001 level

Table 8. Post-hoc test for content type and Log (weighted engagement) overall and on Facebook and Instagram

(I) Content type	(J) Content type	Overall mean (I-J) difference	p	Facebook Mean Difference (I-J)	p	Instagram Mean Difference (I-J)	p
Inspirational	Entertaining	-0.43761	0.518	-1.12685	0.213	0.17346	0.849
	Transactional	0.55633*	0.000	0.46102*	0.042	0.31254*	0.000
	Cooperative	0.43916*	0.001	0.55555*	0.013	0.22260*	0.019
	Miscellaneous	0.77515*	0.000	0.32246	0.349	0.72104*	0.038
Entertaining	Transactional	0.99395*	0.017	1.58787	0.053	0.13908	0.939
	Cooperative	0.87677*	0.041	1.68241*	0.039	0.04915	0.999
	Miscellaneous	1.21276*	0.004	1.44931	0.085	0.54758	0.371
Transactional	Cooperative	-0.11718	0.923	0.09453	0.992	-0.08993	0.868
	Miscellaneous	0.21881	0.740	-0.13856	0.969	0.40850	0.519
Cooperative	Miscellaneous	0.33599	0.324	-0.23309	0.832	0.49844	0.312

* The mean difference is significant at 0.05 level

DISCUSSION AND CONCLUSION

The main purpose of this study was to explore three interior design brands' postings on Facebook and Instagram and to analyze consumer engagement towards the posts. We raised two research questions. Our first research question was: What type of content are interior design brands posting on Facebook and Instagram? Based on a content analysis we identified the following content types: Inspirational, Entertaining, Transactional, Cooperative and Miscellaneous. Most posts on both social media sites were of inspirational character, but Facebook was compared to Instagram used more for transactional and miscellaneous postings, while Instagram relative to Facebook was used more for inspirational postings. Entertaining and cooperative posts were quite evenly distributed on both sites. This shows that slightly different content strategies are used on the two social media sites. Facebook does have better linking features to e.g. external Web sites/stores, which may promote a more transactional content strategy. Instagram again is based mainly upon visual postings such as photos or images, which may boost more inspirational posts by brands. Instagram is an image and visual content dominant social media platform (Virtanen, Björk & Sjöström, 2017).

The results also show that the three interior design brands investigated are actively present in social media, they have a regular posting frequency in both Facebook and Instagram. The peaks of posts occur before Christmas and during other major events

and festivities, which is quite typical on social media sites (Coelho, de Oliveira & de Almeida, 2016). The importance of frequent brand updates in social media has also been emphasized in previous studies (Ashley & Tuten, 2015).

The second research question that we raised was: Are there differences in consumer brand post engagement on Facebook and Instagram? The results show that the levels of consumer engagement vary between the two social media platforms. The brands in this study had more followers on Facebook than Instagram, which ought to lead to higher engagement on Facebook due to the potential of higher reach. However, in this study Instagram showed a significantly higher weighted consumer brand post engagement rate than Facebook, and the type of social media site showed a significant main effect on the weighted engagement. Also the interaction effect between the type of social media site and content type was significant. This is in line with previous research that different social media sites generate different levels of engagement (He, Zha & Li, 2014). The user base on Instagram is also younger (AudienceProject, 2017; Pew Research Center, 2018), and the Instagram fans may thus be more active in social media in general. According to Pew Research Center (2018) young adults stand out in frequency of social media use. Moreover, there seems to be a consensus among industry experts that free brand post exposure has dropped especially in Facebook, e.g. due to the algorithms in the news feed. Still social media engagement rates of 1 – 3% are quite good according to some professional online sources. In this study the overall weighted engagement rate on Facebook was 1.01% and on Instagram 2.72%.

Based on our further analysis we found that inspirational and entraining content gained the highest weighted engagement numbers overall. On Facebook a few prize competitions (here categorized as entertaining content) generated very high engagement numbers. Entertaining content and competitions for prizes have also by other studies been found to generate high consumer engagement levels on social media sites (Tafesse, 2015; Schultz, 2017; Cvijikj & Michahelles, 2013). On Instagram inspirational posts clearly generated the highest weighted engagement numbers, albeit there were only 9 cases (omitted) of entertaining content. Nevertheless, it seems like the brand fans on Instagram are engaged by inspirational interior design branded content and are not only looking for deals, contests for prizes or similar. Brands should be careful that the consumers might mainly follow a brand in order to qualify for discounts or different types of coupons (Ashley & Tuten, 2015). Hence, evoking emotions in social media does seem to be an interesting communication strategy for brands (Taecharungroj, 2017). Building an emotional bond with brand fans in online communities may also deepen the fans' affection and passion for the brand (Hsu, 2019). Emotional engagement is an important dimension in the theoretical foundation of consumer brand engagement (Hollebeek *et al.*, 2014).

Limitations And Further Research

As clearly shown in the literature review of this paper, different studies use different content classifications and consumer brand post engagement metrics on social media sites, and thus it may be hard to directly compare results between different studies. Here, we defined content types as Inspirational, Entertaining, Transactional, Cooperative or Miscellaneous, which we found appropriate based on previous research and the data set in the context of interior design on two different social media sites. The results are delimited to the context of interior design and three Finnish brands. The interior design market is aesthetically driven and hence the characteristics of Instagram as an image and visual content dominant social media platform ought to fit well within interior design. Previous research confirms that there are differences between industries how content influence engagement in social media (Kim, Spiller & Hettche, 2015; Schultz, 2017). Therefore, future studies could have a larger data set from different types of industries. Cultural aspects could also be interesting to study, and other posting characteristics such as media type (text, photo and video) could be included in the analysis. The formula used for the weighted consumer engagement could also be critically reviewed. In this study we did not consider emotional emoji reactions and thus including emotional reactions to the weighted engagement formula could be an interesting aspect to consider in further studies.

Conclusion

To sum it up, this study contributes to previous research regarding content type and consumer engagement in social media marketing and hence it helps to understand what type of postings on two social media sites drive consumer brand post engagement. It also adds to the theoretical discussion on consumer engagement. Engagement on the two social media sites is enhanced by entertaining and inspirational content. Especially on Instagram, inspirational content created the highest brand engagement. From a managerial perspective, this study shows the importance of monitoring and analyzing postings on different social media sites. A primary insight in this study was the differences in consumer brand post engagement between Facebook and Instagram, where Instagram had a higher engagement level. Brands that want to achieve business advantages using social media need to regularly analyze themselves and their competitors on different social media sites. Future research could replicate this study by taking into account the discussed limitations and improving upon them.

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Consumer Satisfaction and Repurchase Intention from Cross-border e-Commerce: A Trust-Risk-based Study

(Full Paper)

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ABSTRACT

E-commerce is a fast-growing economy today. The waves of cross-border e-commerce has also been accelerated resulting in big opportunities as well as threats to firms. Understanding consumer perception towards cross-border e-commerce is crucial especially perception of trust and risk towards cross-border e-commerce for the consumers need to transact with the system that may lead to various vulnerabilities. Moreover, the consumer loyalty is also critical for business in the central of highly competitive market to ensure sustainable profit and stable market position. In this study, Trusting Belief and Perceived Risk are major constructs incorporated with Expectation-disconfirmation Theory to extend the knowledge of e-commerce study by focusing on cross-border e-commerce amongst the consumers in Thailand. Trusting Belief and Perceived Risk are formed into expectation and performance constructs in accordance to Expectation-disconfirmation Theory to evaluate the pre-to-post purchase perception. The Structural Equation Model suggests that the post-purchase trust and perceived risk are highly influence to the expectation disconfirmation of which results in satisfaction and repurchase intention from the e-seller. In term of cross-border e-commerce, consumer expectation towards risk and trust on e-sellers is vary and not significant. They tend to expose themselves to risk at first; however, the post-purchase trust and risk are highly influential and shape a firm perception of trust and risk towards the e-sellers.

Keywords: e-commerce, cross-border e-commerce, trust, perceived risk, repurchase intention, Expectation-disconfirmation theory.

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INTRODUCTION

Electronic commerce, or E-Commerce, is inarguably growing and expanding throughout the world. Market value of E-Commerce triplicates from about one million US dollars in 2012 to 3 billion USD in 2017 globally. Electronic commerce offers customer various benefit on shopping such as variety of product, fast searching, decreasing asymmetric of product information, etc. (Amaral, 2017). International electronic trade or cross-border E-Commerce has been enriched thank to technology advancement and connected world. It is today's growth rocker in E-Commerce with USD 300 million market size in 2017 and average growth of 20 percent per year (DHL Express, 2016). ASEAN, Association of South East Asian Nations, has announced that they will boost digital economy throughout the region which will benefit cross-border E-Commerce. The ministry of trade and industry of Singapore said that they would support advanced payment and transaction to help small and medium firms to expand their E-Commerce; however, there are challenges for less developed counties such as Myanmar, Cambodia, and the Philippines on logistic and internet penetration (Iwamoto, 2018).

In the customer perspective, the E-Commerce benefits their shopping. Consumers across markets are motivated to shop cross-border for fundamental reasons - product availability, a more attractive offering (including price), and trust. Fashion and electronics are long-known cross-border top sellers, but consumers now crave more on other product categories such as beauty and cosmetics, pet care, food and beverage, and sporting goods (DHL Express, 2016) However, cross-border e-commerce has received relatively less research attention than in domestic e-commerce context (Xiao, Wang, & Liu, 2018) while the business has been changing very fast. Cross-border E-Commerce in Thailand has been growing in accordance to the region trend. In Thailand, E-Commerce has been adopted for many years with the linear increasing sales from 2,865 million USD in 2015 to 4,239 million USD in 2017 (Priest, 2017). Studying on Thailand's population is interesting due to a high growth in both digital commerce adopters and Thailand is part of South East Asia region which is a fast-growing region in e-commerce market (Priest, 2017).

In this study, we develop research questions on the cross-border e-commerce that need to be answered. Do consumer trust expectation and risk expectation influence consumer disconfirmation and later trust and risk perception towards cross-border e-commerce or not? Do disconfirmation of consumer trust and risk expectation, consumer satisfaction, post-purchase trust and risk perception influence repurchase intention from cross-border e-commerce or not? Does consumer trust affect perceived risk at the pre-purchase stage as well as post-purchase stage or not? Do consumers expect trust and risk from cross-border e-commerce sellers and domestic e-commerce sellers differently across the pre-purchase and post-purchase stage or not?

LITERATURE REVIEW

Expectation-Confirmation Theory

The expectation-confirmation theory has been widely adopted and many fields of study, especially marketing field. The theory extensively studies the post-purchase experience involving customer satisfaction and continuance of using services or

repurchase based on their satisfaction of prior purchase, usage of services, or adoption. The theory proposes that the expectation which is a pre-purchase stage affects the confirmation or disconfirmation of the belief which can be resulted in actual purchase or adoption (Oliver, 1980). Satisfaction in the theory refers to the customer overall satisfaction after adoption, purchase, or usage of product or services. Although ECT has been widely adopted in marketing field; however, many researchers discuss that the theory ignores viability of the post-experience expectation i.e. the customer changes their perception after period of time after making purchase from negative to positive or vice versa due to intermediate effect of environment possibly social influence and marketing campaign (Bhattacharjee, 2001).

Trust

The definition of trust is complicate due to its abstract and complex factor nature. Trust has been addressed in many previous researches with vast definition and stages (Bonsón Ponte, Carvajal-Trujillo, & Escobar-Rodríguez, 2015). Several theories regarding trust are diverse into many stages of the interaction between trustee and trustor (Stouthuysen, Teunis, Reusen, & Slabbinck, 2018). Trust has been studied in many fields, yet the diverse conceptualisation of trust is ununified. Trust is of central importance in this decision (Fisher & Zoe Chu, 2009) reflecting the willingness of a party to be vulnerable to the actions of another party based on positive expectations regarding the other party's motivation and/or behaviour. In the field of electronic commerce, trust formulate a belief of the consumer on the seller to the extent of positive belief. Due to the nature of the electronic commerce, consumers experience uncertainty of the online purchase; therefore, trust plays an important role as a solution to uncertainty/risk (Kim, Ferrin, & Rao, 2008, 2009). On McKnight and Chervany's previous research in the area of electronic commerce proposes a decomposition and conceptualisation of trust and the antecedents of trust that trust constructors can be differentiated into two dimensions which are Institutional trust and dispositional trust (Harrison McKnight & Chervany, 2001). The disposition to trust means the extent to which one displays a consistent tendency to be willing to depend on others in general across a broad spectrum of situations and persons (McKnight, Choudhury, & Kacmar, 2002) while institutional trust refers to an individual's beliefs about the structural safety or favourability of the conditions beyond a given transaction and beyond specific sets of exchange partners (Harrison McKnight & Chervany, 2001).

Perceived Risk

Risk is one of the most important factors to study in cross-border e-commerce due to its uncertainty in transaction and experience. Cross-border online shopping is an unfamiliar and uncertain activity for consumers, more so than domestic electronic commerce (Lesma & Okada). Risk is a situation that that may be resulted in uncertainty or negative consequence (Naovarath, 2015). Risks may be classified into various types such as Jacoby and Kaplan's seven type of risks which are financial, performance, physical, psychological, time, social, and opportunity cost risk (Kim et al., 2008). Likewise, risk can be grouped into System-dependent uncertainty and Transaction-specific uncertainty according to study from (Rouibah, Lowry, & Hwang, 2016). In the previous research from Featherman and Pavlou on the consumer risk on an aspect of consumer behaviour, they intensively study the various aspect of risk and classify them into 7 facets of risk which are performance risk, financial risk, time risk, psychological risk, social risk, privacy risk, and overall risk (Featherman & Pavlou, 2003).

Trust-Risk Interaction and EDT Model

Pavlou's study on Trust and Risk interaction towards Intention suggest that Trust affects Risk (P. A. Pavlou, 2003) based on TAM (Technology Acceptance Model) in accordance to the study by Kim et. al. which conduct longitudinal study based on EDT suggests the same effect direction (Kim et al., 2009) as well as the work done by Zhu et. al. in later year (Zhu, Neal, Lee, & Chen, 2009). Trust and Risk are not very influential to customer intention to repurchase or continuance intention (N. Lankton, McKnight, & Thatcher, 2014) even though the previous study shows strong relationship of Trust to intention to use in TAM model (Gefen, Karahanna, & Straub, 2003; Pappas, 2016; Rouibah et al., 2016). This conflict of relationship is due to strong and dominant effect of customer satisfaction (Mou, Shin, & Cohen, 2015) in the Expectation Disconfirmation Theory while TAM does not incorporating Satisfaction into the Theory. This research incorporates the trust and perceived risk into EDT model together where trust have positive effect on disconfirmation while perceived risk influence disconfirmation negatively.

METHODOLOGY

Population and Sample

Based on Statista, 12.1 million Thailand's online shopper is estimated in 2017 and the number of digital shoppers is estimated to 13.9 million in 2021; however, no evidence from any sources that classify number cross-border shoppers is addressed; therefore, the population for our study is unknown within the 12.1 million users. Sample size for analysis is calculated based on Cohen's guideline for power analysis (Cohen, 1988) resulting in 416 minimum sample size for the inference ($u = 6$, $f^2 = 0.05$, Power Test ($\beta = 0.95$, Significant Level ($\alpha = 0.05$). In this study, the paired t-test (Confidence Interval = 0.95, Significant Level ($\alpha < 0.05$) is used as well in order to test whether there is any difference between pre and post purchase trust and risk as well as pre and post purchase trust and risk towards domestic e-commerce and cross-border e-commerce. The data are collected via online form and Facebook.

Data Analysis

This study conducts a confirmatory factor analysis and Structural Equation Model to confirm the previous theory and quantify the relationships between latent variables. There are several tests that are conducted and addressed in this study to ensure non-

violation assumptions which are normality test (result from CFA), construct validity analysis, and reliability analysis. The conceptual framework was developed for ease of understanding the relationship paths (refer to Figure 1) and research hypotheses are formulated as shown on Table I.

Table 1 Research Hypothesis

No.	Hypothesis
H1	Trusting Expectation from cross-border e-commerce has negative effect on Perceived Risk Expectation from cross-border e-commerce.
H2	Trusting Expectation from cross-border e-commerce has positive effect on Expectation Disconfirmation from cross-border e-commerce.
H3	Perceived Risk Expectation from cross-border e-commerce has negative effect on Expectation Confirmation from cross-border e-commerce.
H4	Trusting Performance from cross-border e-commerce has positive effect on Expectation Confirmation from cross-border e-commerce.
H5	Perceived Risk Performance from cross-border e-commerce has negative effect on Expectation Confirmation from cross-border e-commerce.
H6	Trusting Expectation has positive effect on Trusting Performance.
H7	Perceived Risk Expectation has negative effect on Perceived Risk Performance.
H8	Trusting Performance has negative effect on Perceived Risk Performance
H9	Expectation Disconfirmation has positive effect on Satisfaction.
H10	Satisfaction has positive effect on Repurchase Intention.
H11	Trusting Expectation from cross-border e-commerce is less than domestic e-commerce on average.
H12	Perceived Risk Expectation from cross-border e-commerce is higher than domestic e-commerce on average.
H13	Trusting Performance from cross-border e-commerce is less than domestic e-commerce on average.
H14	Perceived Risk Performance from cross-border e-commerce is higher than domestic e-commerce on average.
H15	Trusting Performance (post-purchase) is increased from Trusting Expectation (pre-purchase).

PAIRED T-TEST FOR DIFFERENCE PERCEPTION OF TRUST AND RISK

This study expects that the respondents do not perceive cross-border e-commerce and domestic e-commerce differently. The t-test is conducted in 6 pairs which Pair 1 - 4 test the trust and risk in both pre and post purchase stage as well as testing the difference in mean between cross-border and domestic e-commerce. The Trusting Expectation and Perceived Risk Expectation are pre-purchase variables while the Trusting Performance and Perceived Risk Performance are post-purchase variable. Moreover, the Trusting Belief represent in Pair 5 is the test between Trusting Expectation and Trusting Performance from cross-border e-commerce. The result of all 6 pairs t-test is shown on Table 2.

Table 2 Paired T-test Result

			Paired Differences				t	df	Sig. (2-tailed)	
			Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference				
						Lower				Upper
Pair 1	Cross-border vs Domestic e-commerce	Trusting Expectation	-0.260	0.613	0.029	-0.317	-0.202	-8.898	439	.000**
Pair 2		Perceived Risk Expectation	-0.138	0.765	0.036	-0.209	-0.066	-3.784	439	.000**
Pair 3		Trusting Performance	-0.193	0.649	0.030	-0.254	-0.132	-6.262	439	.000**
Pair 4		Perceived Risk Performance	0.007	0.970	0.046	-0.082	0.098	0.172	439	0.864
Pair 5	Pre-post purchase from cross-border e-commerce	Trusting Belief	-0.018	0.488	0.023	-0.063	0.027	-0.780	439	0.436
Pair 6		Perceived Risk	0.178	0.658	0.031	0.116	0.240	5.681	439	.000**

Note. * p < .01. **p < .001.

To summarise, the consumers expect trustworthiness and risk between cross-border e-commerce and domestic e-commerce differently at the pre-purchase stage which they expect cross-border sellers untrusting and risky; however, the consumers perceived that the cross-border sellers is untrustworthy after they have made a purchase. Perceived Risk Performance between cross-border and domestic e-commerce is not significantly different in mean which can be implied that the consumers may not feel the risk in a different level between cross-border and domestic e-commerce.

In term of difference perception of pre-to-post purchase from cross-border e-commerce, consumers expects that the cross-border e-commerce is risky and untrusting but they are lowered after they have purchase from cross-border e-sellers. The summary of hypothesis test is also shown on Table 3.

Table 3 Paired T-test Hypothesis Test Result

No.	Hypothesis	Result
H11	Trusting Expectation from cross-border e-commerce is less than domestic e-commerce on average.	Supported
H12	Perceived Risk Expectation from cross-border e-commerce is higher than domestic e-commerce on average.	Not Supported
H13	Trusting Performance from cross-border e-commerce is less than domestic e-commerce on average.	Supported
H14	Perceived Risk Performance from cross-border e-commerce is higher than domestic e-commerce on average.	Not Supported
H15	Trusting Performance (post-purchase) is increased from Trusting Expectation (pre-purchase).	Not Supported
H16	Perceived Risk Performance (post-purchase) is decreased from Perceived Risk Expectation (pre-purchase).	Not Supported

STRUCTURAL EQUATION MODEL

Structural Equation Model and Confirmatory Factor Analysis are used with Maximum Likelihood Estimator to confirm the theory. This research has developed the hypothesis incorporating trust and risk into EDT. The visual path diagram with the SEM result is shown on Figure 1.

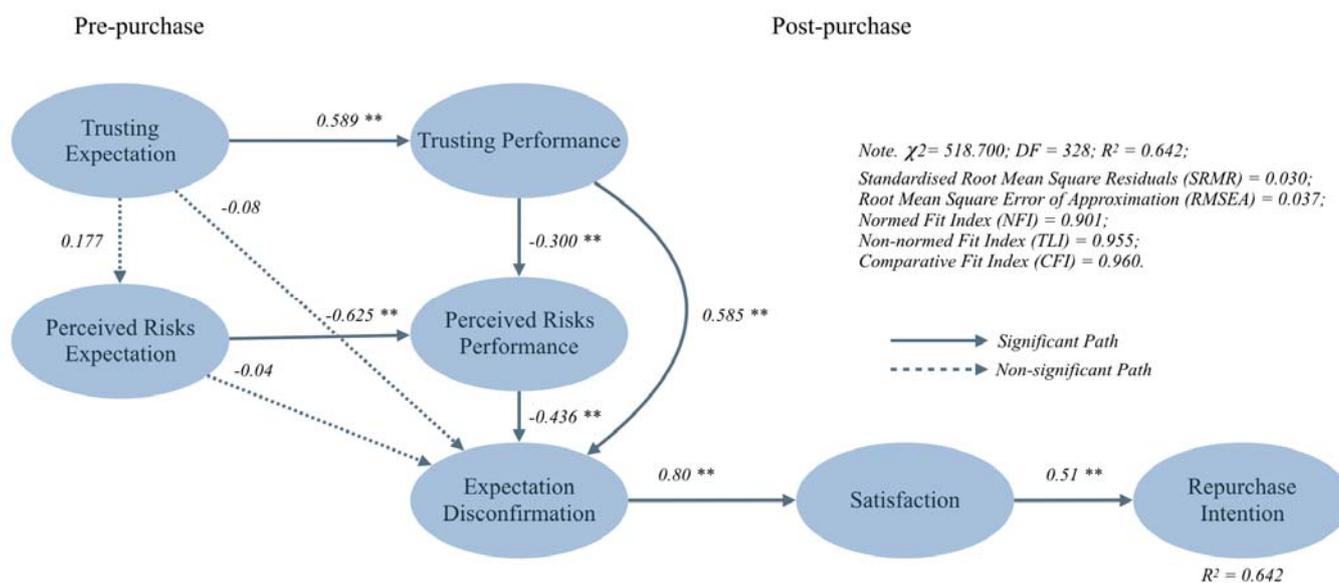


Figure 1: Standardized coefficient path from SEM.

Trusting belief is proposed into Trusting Expectation and Trusting Performance; while, perceived risk is proposed into Perceived Risk Expectation and Perceived Risk Performance. The relationship of each construct is shown on Table 2. There are numbers of goodness of fit index for model evaluation; however, a combination of fit index is also suggested in determining the goodness of fit (Hu & Bentler, 1999) which are combinations of NNFI (TLI) with SRMR, RMSEA in with SRMR, and CFI with SRMR together. The CFA estimates are all significant between measurement items and their construct.

Reliability and validity test are also conducted suggesting that the measurement model is valid and reliable (Cronbach’s $\alpha > 0.7$, Construct Validity > 0.4 , Average Variance Extract > 0.6 , Correlation Coefficients between -0.85 and 0.85). The summary of validity and reliability analysis result are shown on Table 4.

Table 4: Measurement Model Validity and Reliability

Test	Result
Validity	
Convergence Validity	All items in a measurement model are statistically significant. (Refer to Table B.1) Other than that, the value of AVE for all construct is greater than 0.50. The Convergent Validity was achieved the required level. (Refer to Table B1)
Construct Validity	The construct validity was achieved the required level. (Refer to Table B1)
Discriminant Validity	The correlation between all constructs are not lower than -0.85 or higher than 0.85. (Refer to Table B2)
Reliability	

Internal Reliability	The value of Cronbach Alpha is greater than 0.60. The internal reliability was achieved the required level. (Refer Table B1)
Construct Reliability	The value of CR for all constructs are greater than 0.60. The composite reliability was achieved the required level. (Refer B1)
Average Variance Extracted	The value of AVE for all constructs are greater than 0.50. The required level was achieved. (Refer B1)

Direct Effect

This study hypothesises that each construct formulates a direct relationship to the dependent variable. The path between post-purchase construct are significant in term of effect. The consumer’s expectation of Trust is not predictive of Perceived Risk Expectation ($\beta = , p > 0.05$) which is against the previous study on trust and risk interaction (Kim et al., 2008, 2009; Mou et al., 2015; Zhu et al., 2009) on e-commerce. Moreover, the Trusting Expectation to Expectation Disconfirmation ($\beta = 0., p < 0.05$) effect is not significant as well as Perceived Risk Expectation to Expectation Disconfirmation ($\beta = 0.04, p < 0.05$). Trusting Performance is significantly directly influence Expectation Disconfirmation ($\beta = 0.53, p < 0.05$) as well as Perceived Risk Performance which is significantly affect Expectation Disconfirmation ($\beta = -0.43, p < 0.05$) negatively. Trusting Performance negatively affect Perceived Risk Performance ($\beta = -0.30, p < 0.05$) significantly as well. Expectation Disconfirmation is predictive and directly affect Satisfaction ($\beta = 0.80, p < 0.05$), and, Satisfaction is significantly predictive and directly affect Repurchase Intention ($\beta = 0.51, p < 0.05$) which confirm the construct relationships based on EDT in previous study (Ambalov, 2018; Bhattacharjee, 2001; N. Lankton et al., 2014; N. K. Lankton, McKnight, Wright, & Thatcher, 2016; Zhang, Lu, Gupta, & Gao, 2015) in a context of cross-border e-commerce. The hypothesis result of direct influence from latent variables is provided on Table 5.

Table 5: Direct Effect Hypothesis Result

No.	Hypothesis	Result
H1	Trusting Expectation from cross-border e-commerce has negative effect on Perceived Risk Expectation from cross-border e-commerce.	Not Supported
H2	Trusting Expectation from cross-border e-commerce has positive effect on Expectation Disconfirmation from cross-border e-commerce.	Not Supported
H3	Perceived Risk Expectation from cross-border e-commerce has negative effect on Expectation Confirmation from cross-border e-commerce.	Not Supported
H4	Trusting Performance from cross-border e-commerce has positive effect on Expectation Confirmation from cross-border e-commerce.	Supported
H5	Perceived Risk Performance from cross-border e-commerce has negative effect on Expectation Confirmation from cross-border e-commerce.	Supported
H6	Trusting Expectation has positive effect on Trusting Performance.	Supported
H7	Perceived Risk Expectation has negative effect on Perceived Risk Performance.	Supported
H8	Trusting Performance has negative effect on Perceived Risk Performance	Supported
H9	Expectation Disconfirmation has positive effect on Satisfaction.	Supported
H10	Satisfaction has positive effect on Repurchase Intention.	Supported

Indirect Effect

Result produced from SEM analysis suggests indirect effect of the path with mediator which are shown on Table 3 below. The Trusting Expectation has indirect effect on Perceived Risk Performance ($\beta = -0.140, p > 0.05$), Expectation Disconfirmation ($\beta = 0.395, p > 0.05$), Satisfaction ($\beta = 0.249, p > 0.05$), and Repurchase Intention ($\beta = 0.127, p > 0.05$). Although it provides good contribution, the path is not significant ($p > 0.05$). Trusting Performance has positively indirect effect on Expectation Disconfirmation ($\beta = 0.131, p < 0.05$), Satisfaction ($\beta = 0.574, p < 0.05$), and Repurchase Intention ($\beta = 0.293, p < 0.05$) and the path are all significant. The indirect effect of Trusting Performance is highly contributed to Expectation Disconfirmation and Repurchase Intention respectively. Perceived Risk Expectation is not significant predictor in the model; however, it contributes very high on Repurchase Intention ($\beta = -0.910, p > 0.05$). Perceived Risk Performance has negative indirect effect towards Satisfaction ($\beta = -0.349, p < 0.05$) and Repurchase Intention ($\beta = -0.178, p < 0.05$) and this path is significant. Lastly, Expectation Disconfirmation contribute largely as indirect effect towards Repurchase Intention ($\beta = 0.490, p < 0.05$) and the path of this relationship is significant

In term of goodness of fit evaluation, this Structural Model achieved most of the criteria. The Non-normed Fit Index (NNFI or TLI) is the only one that does not achieve. This indicates that the model is of good fit. The summary of fit index is provided on the Table 5.

Table 6: Model Fit Index

Fit Index	Criteria	Model Result	Model Fit Acceptance
<i>Comparative Fit Index</i>			
NFI	NFI > 0.95	0.901	Not Accepted

Fit Index	Criteria	Model Result	Model Fit Acceptance
TLI	TLI > 0.95	0.955	Accepted
CFI	CFI > 0.95	0.960	Accepted
<i>Other Fit Index</i>			
SRMR	SRMR < 0.08	0.055	Accepted
RMSEA	RMSEA < 0.07 (RMSEA < 0.03 excellent fit.)	0.037	Accepted
<i>Combination Criteria</i>			
NNFI (TLI) and SRMR	NNFI (TLI) \geq 0.96 and SRMR \leq 0.09.		Not Accepted
RMSEA and SRMR	RMSEA \leq and SRMR \leq 0.09.		Accepted
CFI and SRMR	CFI \geq 0.96 and SRMR \leq 0.09		Accepted

CONCLUSION

This study has confirmed that the performance constructs of trust and risk are settled well within Expectation-disconfirmation Theory; however, the relationships between trust and risk expectation towards expectation disconfirmation of consumer in this study is insignificance. It is very important to firms who would like to gain higher competitive advantages over the others to pay their attention to building trust towards the customers and to reduce risks over systems and processes. A proper management on trust and risk in cross-border e-commerce or domestic e-commerce will be resulted in higher satisfaction and loyalty of the consumers. In the context of domestic e-commerce providers, trust and risk are crucial factors to compete with this new era of digital colonisation, cross-border e-commerce expansion and technology disruption, as reflected on t-test that the consumers still believe that domestic e-sellers are more reliable, trustworthy, and less risky. If the belief is confirmed and intensified positively, the domestic e-commerce sellers will position themselves strongly against big influential cross-border e-commerce firms.

LIMITATION AND RECOMMENDATION

This study was conducted on Thai population only. The result may not be applicable to people in different countries or different social and culture context. Additionally, the cross-border e-commerce in Thailand is still at a growing state. Moreover, risks in this study are evaluated as a general perception in combination of financial risk, delivery risk, and overall risk. This study measures the pre-purchase expectation as consumer recall of their past experience rather than measuring before the actual purchase; therefore, the responses to trust and risk expectation may be distorted by long period of past memory before answering the questionnaire.

The result from this study shows that the incorporating trust and risks into the EDT model is significant in the post-purchase stage; however, the interaction on the trust and risks expectation (pre-purchase) towards expectation disconfirmation does not support the hypothesis. The future research on cross-border e-commerce may observe their relationships again which may result in different outcome. The perceived risk in this study may be separated and emphasize independently in the future research to study on different aspect such as financial risk, performance risk (product defection or bogus), and overall risk. Moreover, the research design in the future may conduct twice in a style of longitudinal study separating the pre-purchase and post-purchase measurement conducting on the same samples.

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APPENDIX A: Measurement Items

This section includes measurement items used in the questionnaire for data collection and analysis. The Measurement Items are each listed with adaptation and original sources on Table A1 below.

Table A1: Measurement Items Development

Construct	Measurement Item	Adapted from
Trusting Expectation Trusting Performance (Cross-border and Domestic e-commerce)	This seller is trustworthy.	(Kim et al., 2008) (Gefen et al., 2003) (P. A. Pavlou, 2003)
	The seller would be willing to help when there is question or problem.	(McKnight et al., 2002)
	The seller would keep promises and commitments for their services.	(Pavlou & Fygenson, 2006)
	would provide product and services information correctly.	(Pavlou & Fygenson, 2006)
Perceived Risk Expectation Perceived Risk Performance (Cross-border and Domestic e-commerce)	Purchasing from this Website would involve more product risk (i.e. not working, defective product).	(Kim et al., 2008)
	Purchasing from this seller would involve more financial risk (i.e. fraud, hard to return).	(Hong, 2015) (Featherman & Pavlou, 2003) (Kim et al., 2008)(Kim et al., 2008)
Expectation Disconfirmation (Cross-border e-commerce)	Overall, most of my expectations were confirmed.	(Mou, Cohen, Dou, & Zhang, 2017)
	My experience with purchasing from this seller was better than what I had expected.	(Mou et al., 2017)
	Overall, purchasing from this seller was not risky as expected.	<i>New item</i>
	Overall, purchasing from this seller is trustworthy as expected.	(Kim et al., 2008) (Pham & Ahammad, 2017)
Satisfaction (Cross-border e-commerce)	I am satisfied from purchasing from this seller.	(Pham & Ahammad, 2017) (Sfenrianto, Wijaya, & Wang, 2018)
	Overall, I am quite satisfied with my experience dealing with e-sellers.	(Kim et al., 2008) (Featherman & Pavlou, 2003)
	I have good impression with the service provided by e- sellers.	(Pham & Ahammad, 2017) (Kim et al., 2009) (Featherman & Pavlou, 2003)
	Overall, how would you rate your experience purchasing from this seller?	(Kim et al., 2008) (Featherman & Pavlou, 2003)
Repurchase Intention (Cross-border e-commerce)	I intended to continue purchasing from cross-border seller again in the future.	(Featherman & Pavlou, 2003)
	I plan to purchase from cross-border seller again in the future.	(N. Lankton et al., 2014)
	I intend to repurchase from cross-border seller in near future.	(N. Lankton et al., 2014)
	I intend to continue purchasing from cross-border seller.	(N. Lankton et al., 2014)

APPENDIX B: Confirmatory Factor Analysis Summary

This section provides Confirmatory Factor Analysis summary for each construct including factor loading for each measurement items in the measurement model, Cronbach's alpha suggesting sufficient level of covariation between the items in each latent variable, average variance extracted from each latent variable, and the CR for Construct Validity.

Table B1: CFA Construct Summary

Construct	Measurement Item	Factor Loading	α	AVE	CR
Cross-border Perceived Risk Expectation (CBPRE)	CBPRE4	0.674	0.839	0.730	0.862
	CBPRE3	0.701			
	CBPRE2	0.781			
	CBPRE1	0.765			
Cross-border Trusting Performance (CBTRP)	CBTRP1	0.747	0.778	0.691	0.910
	CBTRP2	0.678			
	CBTRP3	0.635			
	CBTRP4	0.702			
Cross-border Perceived Risk Performance (CBPRP)	CBPRP1	0.654	0.807	0.714	0.881
	CBPRP2	0.593			
	CBPRP3	0.919			
	CBPRP4	0.688			
Repurchase Intention (CON)	CON1	0.715	0.804	0.712	0.896
	CON2	0.712			
	CON3	0.674			
	CON4	0.748			
Expectation Disconfirmation (DCE)	DCE4	0.773	0.868	0.785	0.938
	DCE3	0.768			
	DCE2	0.780			
	DCE1	0.820			
Satisfaction (SAT)	SAT4	0.751	0.813	0.699	0.881
	SAT3	0.698			
	SAT2	0.618			
	SAT1	0.730			
Cross-border Trusting Expectation (CBTRE)	CBTRE4	0.669	0.721	0.630	0.876
	CBTRE3	0.628			
	CBTRE2	0.652			
	CBTRE1	0.571			

Note: α = Cronbach's Alpha; AVE = Average Variance Extracted; CR = Construct Validity

Table B2: Cross-border E-commerce Variable Correlations for Discriminant Validity

	CBTRE	CBPRE	CBTRP	CBPRP	DIS	SAT	CON
CBTRE	1						
CBPRE	.512**	1					
CBTRP	0.083	-.191**	1				
CBPRP	.189**	-0.090	.431**	1			
DIS	-.115*	-.389**	.282**	.475**	1		
SAT	-0.006	-.256**	.162**	.439**	.636**	1	
CON	-.120*	-.168**	.123**	.192**	.335**	.222**	1

Note. CBTRE = Trusting Expectation; CBPRE = Perceived Risk Performance; CBTRP = Trusting Performance; CBPRP = Perceived Risk Performance; DIS = Disconfirmation; SAT = Satisfaction; CON = Repurchase Intention

Design memory protection based on embedded operating system with focus on PicoBlaze soft controller

(Full Paper)

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ABSTRACT

In dealing with inefficient operation system in today's e-business environment, the paper focuses on memory protection function based on real-time operating system. Originally, RTOS (Real-Time Operating System) lacks the memory protection feature in the basic system design. Since there is no complete memory protection available for operating systems based on PicoBlaze soft controller, the researcher is dedicated to fill the gap. The research explores how existing embedded operating systems realize memory protection and applies processor PicoBlaze to test such function. In addition, the researcher designed memory protection from hardware and software perspectives. The hardware is designed to have additional unit for memory protection while the software is to design assembler code that enables CPU executing related instructions. After testing and experiment, the result has achieved functional objectives and met requirements under restricted conditions of hardware design.

Keywords: memory protection, RTOS, PicoBlaze soft controller, embedded operation system (OS)

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INTRODUCTION

Contemporarily, electronic business has been faced with various operational challenges over whole supply chains. From a technical aspect, business is increasingly exposed to massive data in virtual environment and largely demanding sufficient operation system to consume data burdens and maintain the efficiency of operation. This paper develops an embedment strategy applied to the operation system, which indirectly controls the hardware. By engaging embedded systems, firms would find it easier for development because such system coordinates programs in different functions to do the same job. Meanwhile, it isolates certain functional programs to reduce couplings among them, enabling easier individual functional modules. Moreover, readability of code in the operation system could be increased, thus leaving more convenience for code maintenance. The operating system could achieve hierarchical management over the code, where the priority of each task and the execution cycle can be expected.

Memory protection is of great significance for embedded systems. Sufficient protection over memories can enhance system reliability and safety. It exactly prevents systems from data crash and is applied to a large range of areas such as life support system and avionics. Traditional memory protection involves logical (virtual) memory and process model programming environments, where each process has a separate virtual address range that maps to physical memory. However, this approach results in extra overhead such as extra memory for page tables and additional performance loss of data transfer between processes. To overcome such limitations, embedded applications offer solutions, by taking advantages of the smallness in size, easiness of use and efficiency of the underlying RTOS (Real-time Operating System). Such simple mechanism can set up boundaries around key data structures and critical threads to prevent accidental access. The operating system can access and control each page of its memory. Since virtualized addresses are superior in terms of security, in that case, OS (operating system) could protect sensitive data by binding data and unauthorized code to code virtual address space. Simply speaking, in a virtual memory system, any applications want to access data when it is running, should have their data and code mapped to the same virtual memory system (Lee & Park, 2017). However, micro-embedded processors are rarely used in virtual memory mainly because of large demands for calculations, which are infeasible in a small processor.

Overall, this project aims at developing memory protection based on a small embedded operating system RTOS (Real-time Operating System). The RTOS acts as backdoors that control the execution of a number of application subtasks and facilitate communications between the subtasks (Predko, 1999). The project adopts PicoBlaze soft-processor from Xilinx to test proposed memory protection method. Inevitably, micro-controller is impossible to implement virtualized memory management since it has neither enough memory space to support the mapping of virtual addresses or computing power to support tremendous data processing. Therefore, the system chooses a hardware memory management module MPU to complete memory protection. MPU assumes the system having a single physical memory space and has nothing to do with the number of process running on the device. The storage space is divided into multiple areas and every process will be assigned a set of zones associated with specific access rights given by the operating system. When the system is running, memory protection unit will check each process constantly to ensure data access complying with its permissions to enforce access rules. This approach saves the overhead of virtualization and simplifies the access control mechanism in the processor.

This paper starts with the literature review to illustrate and analyse how existing embedded operating systems or operating systems of microprocessors achieve memory protection. By reviewing past research, this section provides comprehensive views on how they develop the system and implement the memory protection. Followed by the problem analysis, this section offers more insights about designing this research system. The next section concentrates on design and implementation. Research issues will be provided with solutions, where it considers both software and hardware aspects. Moreover, next section is for result evaluation based on kernel real-time quantitative indicators of the embedded RTOS. The final section will put out the conclusion, conclude the whole research and make prospects for further exploration in related sectors.

LITERATURE REVIEW

Soft-Processor

CPU

Xilinx provides the PicoBlaze microprocessor, an 8-bits soft-processor which can be run on the FPGA like Spartan-3, Virtex-II and Virtex-II PRO (Chapmen, 2011). As Figure 1 shows, the internal structure of the KCPSM3 (PicoBlaze) can occupy 96 slices on Spartan-3 board. A single block RAM can be used to store 1024 instructions for a program. Theoretically, the performance is expected at about 43 to 66 million instructions per second at 87MHZ frequency. Performance varies due to the device type. By comparison, the internal structure of ARM7 is more complicated than that of PicoBlaze. The IPS of ARM7 is 40 MIPS at 45 MHZ, which is less than its counterpart indicating that PicoBlaze is a well-performed micro-controller.

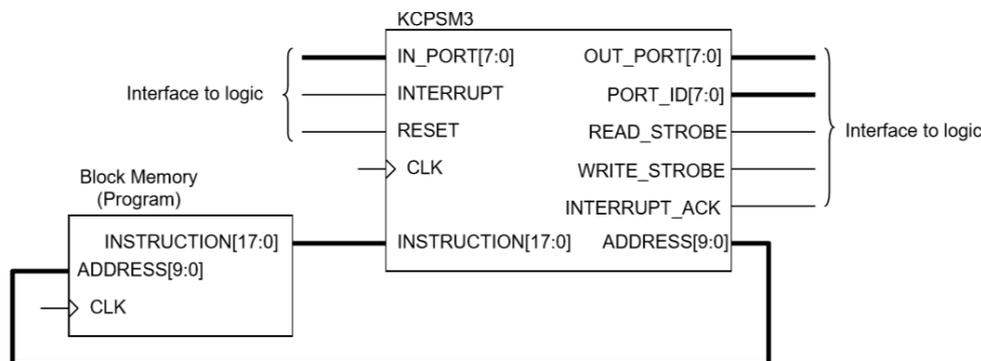


Figure1. PicoBlaze block diagram (Chapmen, 2011)

PicoBlaze is in RISC architecture (Reduced instruction set computer). It contains 16 registers and a stack and could store 31 return addresses. Apart from that, PicoBlaze has a bank of scratchpad memory with 64 addresses. Moreover, PicoBlaze has a strong expansion and is easy to connect 256 I/O ports to hardware. Considering the objective of this project with regards to memory protection design, more insights of the memory architecture of PicoBlaze are required.

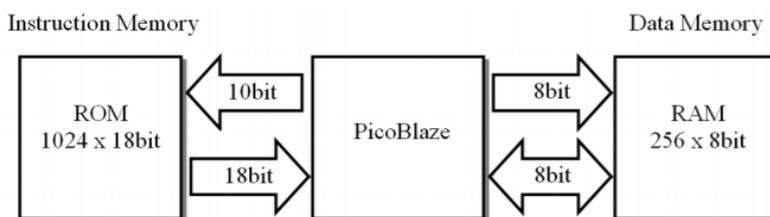


Figure 2. PicoBlaze memory configuration (Freeman, 2005)

As is shown in figure 2, Picoblaze uses the Harvard memory architecture, which is characterized by physical separation of memory instructions and data. Therefore, data cannot be stored in instruction memory (Freeman, 2005). Since each instruction takes two clock cycles, as mentioned in introduction, MPU will be added to protect memory.

KCPSM3 Architecture

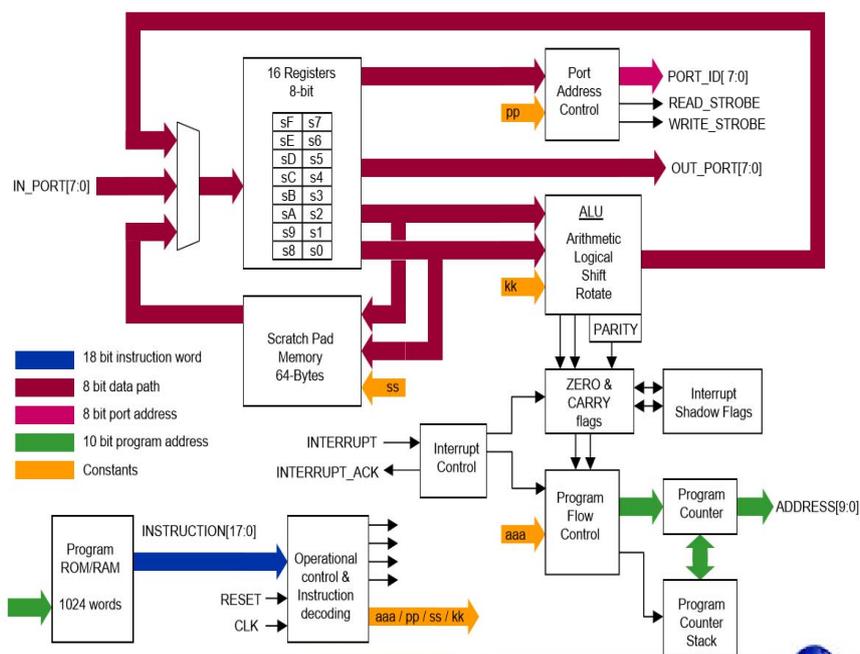


Figure 3. PicoBlaze internal structure (Chapmen, 2011)

Figure 3 exhibits the internal architecture of PicoBlaze. It pictorially shows how the address links each unit inside. KCPSM3 supports a program that is up to a length of 1024 instructions and uses one block memory. The length of data is 256. The ALU (Arithmetic Logic Unit) provides simple operations in processing unit. There are basic logical operations like ADD and SUB and others such as ADDCY and SUBCY that are more than 8-bits operations with carry flag.

Interrupt is a very important signal in KCPSM3 and takes an irreplaceable role in system design. PicoBlaze calls the instruction at address 0x3FF from which users can define jump vector to ISR (Interrupt Service Routine). At this time, INTERRUPT_ACK will generate a pulse on the output. In the final design, the system will trigger the interrupt service routine based on the interrupt signal to handle tasks of the highest priority.

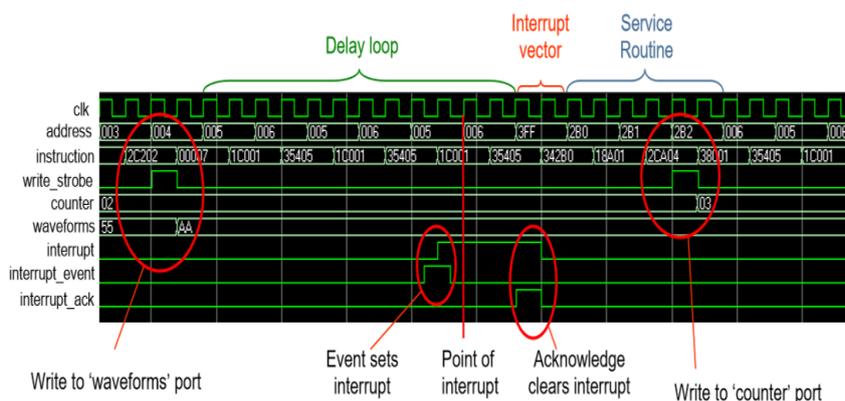


Figure 4. Waveform of interrupt signal (Chapmen, 2011)

Figure 4 presents the waveform of the whole interrupt operations. When delay loop begins, it only repeats the address 005 and 006. Before calling the instruction at 3FF address, there is a need for clock cycles to respond. After defining a jump vector, the interrupt service routine follows. At the same time, the INTERRUPT_ACK signal increase in the waveform, showing that it captures of interrupt signal.

Programming tools

Overall, the programming is divided into software and hardware. The software is OpenPICIDE, an assembler development environment for soft-core processors provided by Xilinx (Fautronix.com, 2018). It includes assembler, compile and simulator used for debugging code. The main function of OpenPICIDE is used to make instruction memory to be read by PicoBlaze.

PicoBlaze requires the instruction memory since it lacks instruction store as a VHDL module. The assembler can produce ROM files added into the system.

The hardware is also provided by Xilinx namely ISE. Since embedded feature of ISE meets project requirements. MPU of the hardware part is compiled via ISE. Moreover, ISE provides ISim, a simulator that can check hardware error and does not need to flash system into FPGA board. Additionally, it is able to view the value of the signal at every clock cycle (Xilinx.com, 2011).

Embedded Operation System

Comparing to general operating systems, embedded OS is featured by initiatives to keep things simple and efficient. To specify, there are few software layers between user and hardware. Meanwhile, it supports a limited range of hardware device. The basic structure of embedded OS is provided by Dr. Mike. namely RTOS (Real-time Operating System). RTOS can accept and process at a fast speed whenever external events or data are generated. The processing result can control the production process or respond quickly to the processing system within limited time. There are three representative features: 1) high-precision timing system (Xiaodan & Hongbin, 2007); 2) multi-level interrupt mechanism; 3) real-time scheduling mechanism (Cho et al., 2006).

As for data structure, OS is expected to achieve core functionality that is to store vital information to support operating the system. Task structure is very important when a process is created.

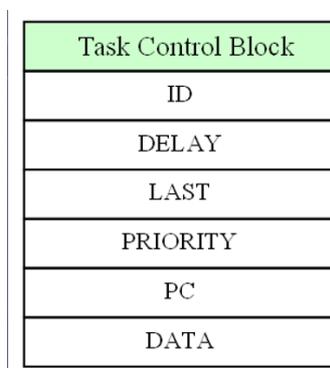


Figure 5. TCB block diagram

Figure 5 shows the TCB structure of a task. Each task will be assigned a priority level so as to determine what task should be executed then. The data structure is stored in memory. Information of task status indicates its execution. PC and DATA are necessary in hardware design, in which PC refers to instruction address while data stands for data address.

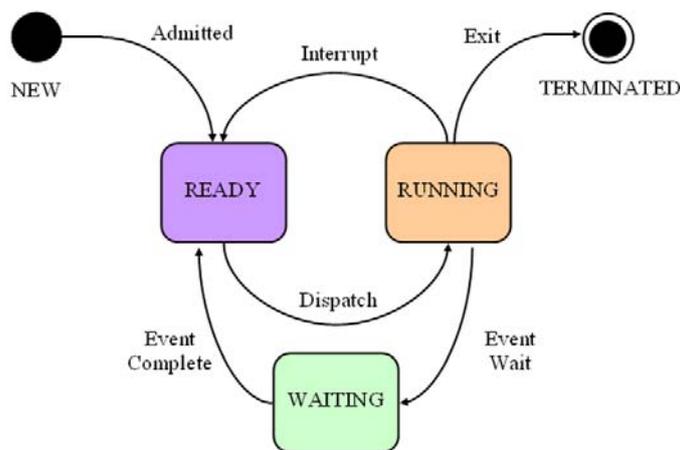


Figure 6. PicoBlaze OS model

The tasks state can be divided into three order lists as shown in figure 6: the ready list, running list and waiting list. Multitasking execution can support several tasks running in the system. However, only one task can be running at a time while other tasks should be prepared to run in the ready list or wait for an event in the waiting list. In hardware design, MPU (Memory Protection Unit) requires recognizing which task is running.

When the system starts executing, the first step is to construct the task and followed by starting interrupt timer in order to trigger the context switch. In addition, context switching is used to schedule different tasks to run on the processor. The

switching order between tasks is based on the priority scheduling algorithm. Moreover, priority of the tasks can be set in advance to determine the switching order. In a general sense, two task queues are required to run the task. Task with the highest priority is right out of a queue. Another queue is used for blocked tasks.

Existing Memory Protection

Hardware support for memory protection

Achieving memory protection with the support of hardware has undergone evolutionary processes. During early years of system protection, memory protection is completely implemented by software without any hardware support. Since mid-1960s, more focus and importance have been attached to hardware support. Initially, hardware approach refers to adding certain easy-to-implement instructions to regular computer instruction set. These instructions are used to transfer functions from the functional segment to the function registers (Wilkes, 1982).

Later, since the computer has a fairly large microprogram memory, new design is proposed as security kernel should be included in the OS design. Though all security-related features are concentrated in the kernel, in order to enable the rest of the operating system having the same protection mechanism as security kernel, it can choose to construct partly of the kernel. Other parts of security kernel need permissions to access.

Additionally, cost issues are worth mentioning. In general, cost is reflected in the extra hardware particularly when extra hardware slows down the running speed and takes up extra memory. Managing costs to a reasonable ratio is a longstanding problem to be solved.

Memory protection system in tiny embedded processors

The system is based on 8-bit microcontrollers, which is similar to Picoblaze. The architecture of tiny processor is very simple, where software modules running on the processor can access the entire memory through a single address bus. Due to resource constraints of processor, the address space could not be divided. To deal with that, the system relies on memory map as a data structure. It can record ownership or layout information of whole address space. The address space of each process is allocated into contiguous segments and each segment is partitioned to a software module.

In addition, software modules are implemented by run-time checks, which can ensure all memory accesses are limited in segment that partitioned to module. However, these are implemented through rewriting compiled binary, which will increase performance overheads in software. To overcome such limitation, the system promotes the implementation of store, call and return instructions in controller to realize run-time check in hardware.

For system structure, memory protection is normally achieved with software/hardware co-design. Such approach eliminates the cost in architecture extensions. Overall, the system is mainly implemented in software, where the memory map can be divided into three parts as protection domains, data structure and memory map checker. The protected domain is created in the data storage address space of embedded processor. Each module stores its status in its own protection domain. Modules are limited to write memory out of their domains while the system is running. Limited memory does not support statically dividing address space into multiple domains. Instead, the address space of the microcontroller is divided into blocks of the same size. Memory map contains access to each address space block and two kinds of information. The first is ownership information for each memory block while the second is encoding information about the memory layout (Kumar et al., 2007).

MMC (Memory Map Checker) is vital in checking the access of software components. Its main function is to enforce the protection model described earlier. Program can only be written to its own domain. As figure 7 shows:

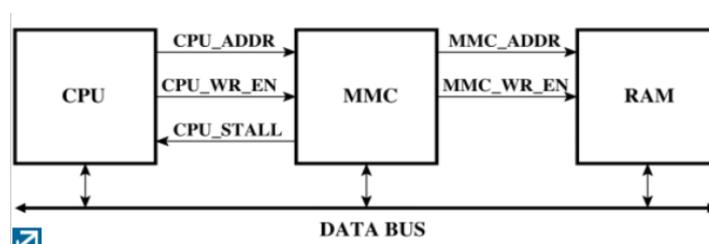


Figure 7. MMC block diagram (Kumar et al., 2007)

MMC works as a unit that intercepts the signal generated by CPU which is used to write to data memory. If the written address is valid, MMC rewrites to the data memory. Such design meets the requirements of this project design. It does not involve additional computing requirements for the processor or take up too much memory. It indeed implements memory protection for RTOS built by PicoBlaze, thus avoiding excessive system resources. For the system itself, those ways designed for memory protection succeed in reaching a trade-off between objectives and resource constraints.

Memory management to support multitasking

The memory management is designed for a FPGA (Field-programmable Gate Arrays), which is based on a computer system. Differing from computers, FPGA fails to support physical MMU (Memory Management Unit) of the microprocessor. To compensate that, MMU can be designed as a module running on the system to handle memory management. Similar to other computer systems, various tasks of this system will share the memory as a resource. However, it is impossible to predict which tasks will be combined and executed in actual system operation. Thus, MMU is expected to support virtual addressing.

Moreover, program storage physically separates from data storage. Data memory of a task can be made up by task registers scattered on the FPGA. FPGA computer can run several tasks at the same time with multiple processors. When multiple tasks accessing the same memory bank, tasks may easily come into conflicts. Under such conditions, an effective mechanism is expected to ensure tasks not affecting each other. In general, a system architecture will have several memory banks for parallel access. The existence of the memory bank is generally flexible, either internal RAM or external RAM. Since external RAM is larger, MMU will manage them in a unified way.

To make data memory addressing of a task independent from other tasks at a time, virtual address is necessary for that. Each task will get an independent memory space mapping in virtual address and begin at 0X00. The virtual address of every task will be translated to physical address. In order to achieve that, MMU needs to store information to enable each task mapping virtual address to physical address. The memory space of RAM will be separated into fixed page number in the same size. Each task memory can be assigned several pages. Page and task affiliation will be stored in MMU.

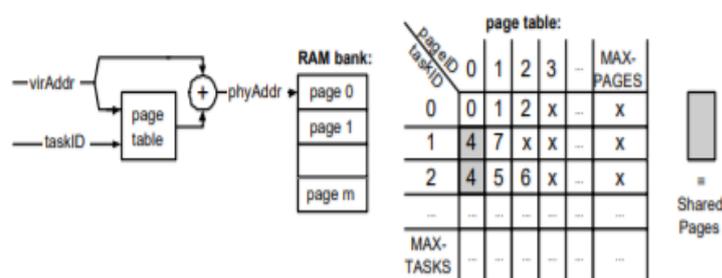


Figure 8. Page table block diagram (Danne, 2000)

Figure 8 as a mapping table shows the correspondence between pages and tasks. Task will use virtual address when it visits memory. The upper part of virtual address can process page table according to task ID. The output of page table will be added into lower part of virtual address (Danne, 2000). This is aimed to get physical address.

MMU can check and recognize whether a task tries to access an address beyond its range of address space. The X mark as shown in the figure indicates that this page does not belong to any task. If the address is invalid, writing access will be denied while reading access will return a value of 0.

Such design implements memory protection as a good example. The FPGA computer system has enough memory to support mapping of virtual addresses. MMU stores mapping information of tasks and checks address mapping. However, they are not the case for this project. PicoBlaze fails to provide enough memory space to support building virtual memory. As an 8-bit microprocessor, the available memory resource is relatively rare. It can only provide a small amount of memory to the task that is far from memory capacity required for virtual memory mapping. Briefly speaking, PicoBlaze is a very small core used for building small systems. Therefore, such design only achieves certain expansion in memory protection.

Memory protection in RTOS

The RTOS is developed for embedded system. The micro-kernel architecture includes process/thread management, which is essential for memory protection, real-time scheduling, communication, timer, and interrupt handler. Memory protection is implemented by memory management software supported by MMU. This system adopts virtual memory concepts, in which 3-level paging is used for memory protection. Besides, memory protection requires MMU and memory management tables, which consists of page tables or segment tables. However, the page size that microprocessor supports is 4-8KB bytes. Such size is too big for a small-embedded system, thus requiring to be reduced. For any small-embedded systems, more efficient memory usage and less memory requirements are very important. Therefore, it is vital to share thread stacks among processes. Additionally, enlarging or shrinking data dynamically based on requirements also promotes the efficiency of memory usage (Suzuki & Shin, 1997).

The memory protection method is generally based on the processing of the address. Memory address is based on physical address or logical address. In general, there are five main types of existing memory protection methods. The first one is Bit Map, which divides physical memory into pages to realize memory protection. In such method, each process needs check the protection information when it accesses the corresponding page. The second approach is segmentation. It splits logical address into multiple segments while each segment will be mapped into physical memory space. This method also needs a memory management table that includes STES (Segment Table Entries) to manage segments.

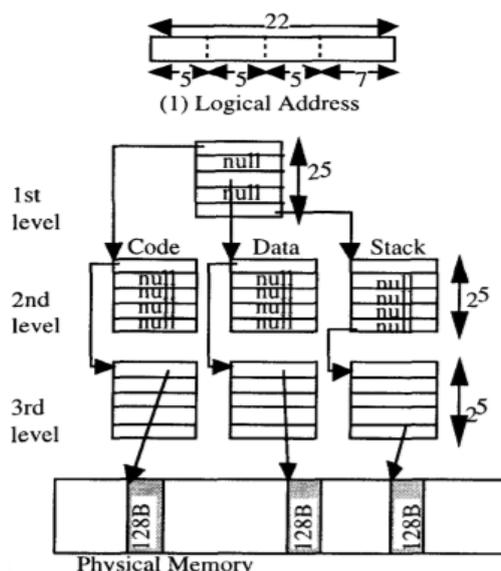


Figure 9. Multi-level page block diagram (Suzuki & Shin, 1997)

The third type is multi-level paging. Figure 9 above shows the structure of multi-level paging as 3-level structure of page table. Comparing with segmentation method, multi-level paging divides logical address into pages of the same size. All pages will be mapped into physical address space. Such way facilitates reducing the size of page tables by hierarchical layer according to different levels.

The fourth method is paged segmentation. Each segment of logical address space is divided into several pages and all pages should be mapped into physical address space. In practice, it uses several page tables and a segment table to manage memory. The fifth approach is short-circuited segment tree. Comparing to multi-level paging, it just uses first page entries, which reduces the overhead processing and total page size. Following figure 10 is the structure of Short-circuit segment tree. Though it presents five levels of pages, it is apparent to find that the first level page table is directly connected to the bottom page table. The second to the fourth-level page table of stack area and data are skipped. This is actually aimed to ignore mid-level pages so that it can reduce processing overheads caused by extra table size.

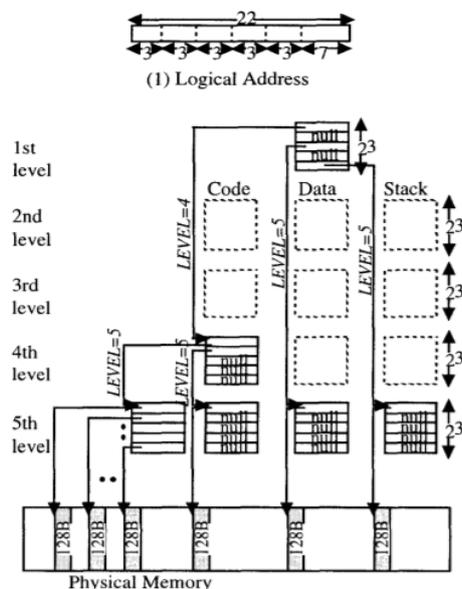


Figure 10. Short-circuit segment tree block diagram (Suzuki & Shin, 1997)

This new memory protection method for small-embedded systems based on modifications on the fifth method. Similarly, this method also skips the intermediate-level page table. The difference is that it enables a PTE (Page Table Entry) in every level page table to map to the physical address space and skip page tables that only one PTE is used (Suzuki & Shin, 1997). This method ignores intermediate-level page tables and uses larger size pages which makes it possible to reduce processing overheads and total table size.

Memory Protection for embedded OS Kernels

OS is developed for embedded OS kernel based on three abstractions. The first one is process as basic unit of execution. The second one refers to files that include a lot of I/O operations. The last one is sockets as implementation of Internet protocols which are available by a socket interface. These three abstractions have an API (Application Programming Interface), which is exported by kernel system call interface.

The design is portable among CPU architecture that provide page-level protection with MMU hardware. The core idea is using page-based memory protection to prevent one process accessing to the memory area of other different processes. In addition, it also prevents user processing access kernel memory. The virtual address is one-to-one mapped to physical address, making all processes assigned with same logical address and physical address. Concerning memory management, a one-to-one mapping greatly simplifies the design of the memory management subsystem.

Moreover, the protection mechanism is based on domain, which consists of memory pages that are mapped with a set of page tables. Apart from that, memory pages related to the kernel are combined into a set called kernel map. Kernel map is mapped to all domains. However, it can only be accessed in special mode (Miler, 2002).

Overall, there are three basic memory management data structures supporting memory protection: region table, page table and kernel map. As defined, region table is an array used for tracking the physical memory. Page table defines protection domain that contains relevant process. Kernel map refers to a list containing all page tables, which can only be accessed by CPU in special mode. These three data structures are used in conjunction through kernel memory management routines.

Furthermore, the basic unit of memory allocation is region. Region is substantially a page alignment and a sequence of consecutive addressable locations tracked with a starting address. In addition, the length should be a multiple of the page size.

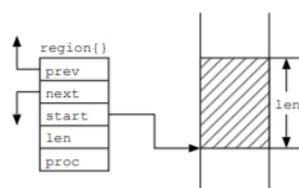


Figure 11. Memory allocation unit block diagram (Miler, 2002)

Figure above exhibits the structure of memory allocation unit. The data structure of region is used to track the allocation of memory. Besides, every region is tracked by its starting address (Start field as shown in Figure 11) and length (Len field as shown in Figure 1). Each region belongs to the process, which is assigned originally, or the ownership has been shifted after allocation. The Proc field is used to track the region belongs to which process currently. Two double-linked lists are maintained with Prev and Next field. The former is free list that shows regions not assigned to any processes. The later is allocated list, which presents regions already allocated to certain processes.

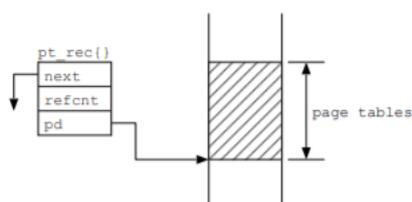


Figure 12 · Page table record data (Miler, 2002)

Figure 12 presents page table record data structure. Kernel can track page tables efficiently with these records in next field. The refcnt field will track total number of threads within the domain when multiple threads are executed through a single protection domain. Moreover, the pd field indicates actual page table data structure. This design suggests that page tables are set up contiguously in memory.

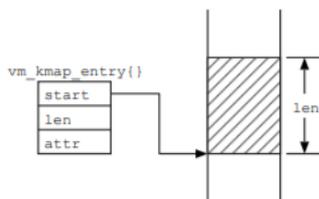


Figure 13. Kernel map entry and associated memory region (Miler, 2002)

In this system, memory is used to hold kernels. The associated data structures of kernel are mapped into all page tables in this system. Moreover, these pages can only be accessed when CPU is run in special mode. Generally, such model will not occur unless there are interruptions or system calls. Briefly speaking, such protection approach is to deny any other forms of memory access to protect kernel's memory.

The kernel mapping is an array of kernel map entries, among which each entry represents a region where it entered in kernel map. Figure 13 shows the structure of kernel map entries. To specify, the Start and Len fields are used to track the starting address and length of the region. The Attr field is used to store attributes associated with pages.

Such design is based on kernel security to implement memory protection, which is suitable for embedded systems. Comparing with traditional memory protection methods, it simplifies code size in address translation and is applicable to different processors.

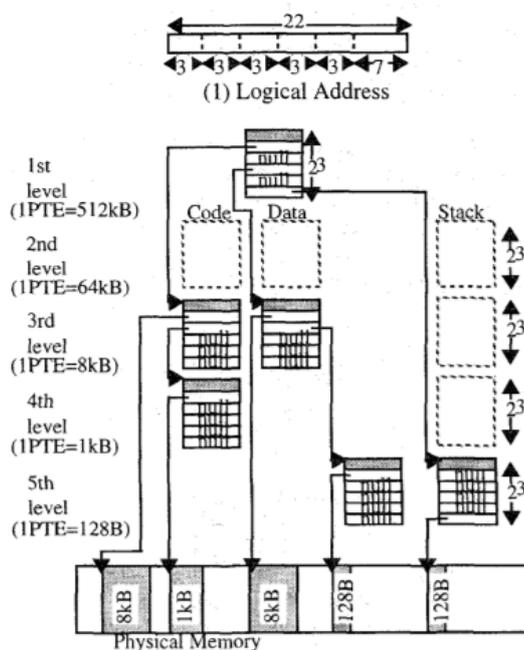


Figure14. Intermediate-level skip multi-size paging block diagram (Suzuki & Shin, 1997)

Figure 14 shows the structure of intermediate-level skip multi-size paging. It skips the stack area from the second to fourth levels while the first level of the page table is directly connected to the fifth level. As mentioned before, virtual address and physical address are mapped through page tables, thus helping achieve memory protection.

This example implements memory protection in a real-time operating system developed for small embedded system. Taken features of small-embedded system into account, such method will enhance memory usage and reduce processing overheads within the scope of system conditions. This method is suitable for this system by modifying in some sections compared to current memory protection method.

PROBLEM ANALYSIS

Operation System Features

Users and files management

Unlike traditional operating systems, this system is run by assembler language and does not require user interaction. Therefore, there is no need to grant user permissions to start a new process. Entering data from the I/O side is the only form of input,

which is generally not entered by user of the device. Such data does not affect execution of programs in the system. So, it does not require user functionality to control system.

Similarly, the file system is of little necessity because operating system can get inputs from sensors to have real-time controls and clear the read data. Since there are no users or files, there is no temporary data to manage. Therefore, building additional management system is unnecessary.

Comparing to other operating systems, there are no complicated interaction and management system. Some common basic security functions are difficult to implement in this project. Basically, it could not get involved in tasks, which are running, leading to a less sufficient error handling. More importantly, it is expected to ensure other tasks working properly when context switches. When the system is in an unknown state, it is suggested to restart.

Concurrency of tasks

As a basic function, processes should be able to run concurrently. Moreover, it is necessary for the system to run tasks at the same time. When the context switches, other operations can be performed. Apart from that, it must also have the functionality as a scheduler that ensures all tasks could run.

Since the key point of this project is to implement memory protection, each task should be able to allocate the required memory and protect the allocated memory when performing memory management. The purpose is to avoid interferences between tasks. Particularly, in facing with weakened error handling mechanism, memory protection plays a critical role in ensuring the system running properly.

System Architecture Design

Considering the limitations of PicoBlaze, basically, the system is expected to avoid making extra overhead. In order to complete the project, the hardware should be modified. At present, adding hardware extensions based on the original system is the least influential on system overheads. As aforementioned in the second chapter, the ultimate design is to build a unit called MPU (Memory Protection Unit) to implement the memory protection. The motive for adopting such design is that PicoBlaze does not have to change itself while it is within the capabilities that it could withstand. The design makes reasonable use of the processor's expansion capabilities, which is the least expensive design method at present.

Moreover, the project is exclusive from other memory protection methods like virtual address mapping for two reasons. On one hand, the system is a small-embedded OS, which could provide enough memory to build page tables. On the other hand, there is insufficient computing power to support calculation of virtual maps. PicoBlaze is a micro-controller that is not capable in massive operations.

Furthermore, due to the expansion of the hardware, the extended hardware should be tested separately to ensure that it could run independently. Followed by testing the whole system, problems could be discovered and processed in a timely manner.

Estimation Of The Result

In the first place, there should be absolute isolation of data memory if the memory protection unit finds that the task access is out of the range beyond its assigned address segment. It should block the access to RAM. In addition, monitoring and protection of shared memory is implemented during inter-task communication to prevent concurrency issues. Under these conditions, this project is expected to be successful. On the contrary, the project is likely to fail if memory protection module does not block the wrong task to write data into RAM in time, or block access to data memory after data have been written into RAM.

Table 1. Features of MPU

F1	Control on/off
F2	Support more than 8 tasks to run
F3	Set address range with base and limit registers
F4	Set read/write authority for address segment
F5	Set address segment for 8 tasks to make comparison
F6	Check task address and block cross-border address access
F7	Give an interrupt signal after a block
F8	Protect RAM (data memory)
F9	Protect ROM (instruction memory)

In addition, MPU should implement above features. Moreover, all tests are list as follow, covering full functions implemented by MPU.

Table 2. Functions of MPU

Name	Method	Function implement by hardware
Test 1	assembler code	Basic function: Load value to register and read from register of MPU
Test 2	assembler code	Block function: Set address segment for one task and access its own base+limit register If valid, MPU lets it pass and write data into RAM. Otherwise, MPU cuts off strobe signal and block the access to RAM
Test 3	assembler code	Interrupt Function: After MPU blocking the access to RAM, the MPU will call an interrupt signal to make system deal with blocked task
Test 4	assembler code	ROM memory protection: Give a prompt signal after detecting that the instruction is out of range

DESIGN AND IMPLEMENTATION

Hardware Design

This research is dedicated to design feasible solution to implement memory protection. As discussed before, there are several design choices. The first one is to design an external hardware called MPU (Memory Protection Unit), of which the structure is simple, and the cost is low. Such design will not take up too much memory resource. The second method is to use virtual memory technique, which is suitable for large operating systems since they can schedule enough memory resource to store address information and support address mapping. The last approach is to establish memory protection mechanism based on kernel, which indeed uses the technology of virtual memory.

Concerning this project, the RTOS is designed as a small-embedded operating system while PicoBlaze is an 8-bit microprocessor. So, it is impossible to implement memory protection with virtual memory technology because of such limited memory resource. On this premise, the project designs MPU to realize memory protection.

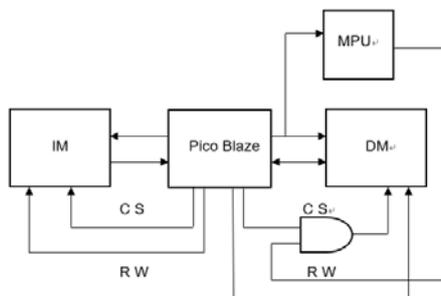


Figure 15. MPU block diagram1

Figure 15 presents a simple structure of MPU, where CPU PicoBlaze could not write data to the ROM (instruction memory). Apparently, the instruction memory is physically separated from data memory. From a security perspective, ROM is much safer than RAM. Therefore, only one MPU is added on the right side to protect RAM. The main job of the MPU is to check whether there is an address out of range, misreading or miswriting. It was connected to the RAM through the logic gate. The kernel will send the address information to the MPU. Once the MPU checks that the address is out of range, the output will be blocked by the MPU and the data could be written to the RAM. In other words, the MPU sets the available address segment and generates a block. It then sends an interrupt signal if wrong address segment is used. Such approach is an external protection method to prohibit cross-border address data from being written to RAM so as to maintain system stability.

In addition, the internal design of the unit is roughly composed of registers. For memory chips, all memory accesses are of equal priority (Silberschatz et al., 1988). The memory hardware does not know or concern which memory part is used. The design idea is to limit the base of the process. The process can only access memory locations that belong to it.

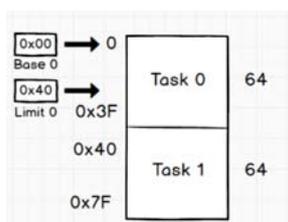


Figure 16. Address allocation diagram

As shown in figure 16, it can be set by adding two registers to determine the range that the process can access. One is the base register and the other is the limit register. To specify, base register holds the smallest physical boundary memory address while limit register limits the range of addresses. Each memory access of a process will compare the address range defined by the two registers. If the process visits wrong address range, it should be blocked as a way to avoid errors (Silberschatz et al., 2009).

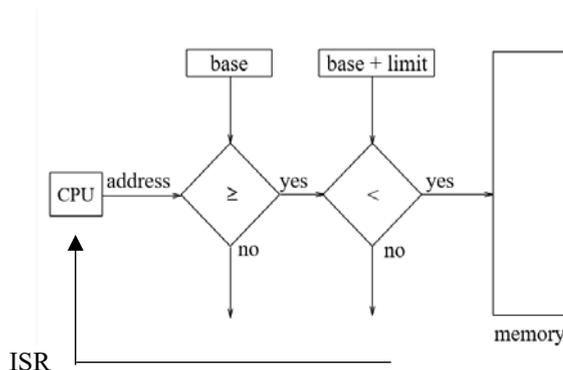


Figure 17. Logical judgment block diagram (Silberschatz et al., 1988)

Figure 17 presents a more detailed hardware design, in which the address is checked by two logical judgments. Only when both logical decisions are YES can the access be allowed into memory. For logical decisions in NO, the MPU will block the access and trigger to interruption. After that, the blocked task will be handled by interruption service routine of the system. Moreover, operating system can access all the memory, where switching code and data in/out of memory is of great significance. Apart from that, the operating system kernel only allows changing the contents of the Base address and limit registers. To further improve the memory protection, the system could simplify MPU structure and add MPU without block functions to protect ROM. When an out-of-range command is detected, there will be a signal like interrupt signal indicating that MPU has figured out the command to be invalid. As for the internal structure of the MPU, the block diagram visually displays the components of MPU.

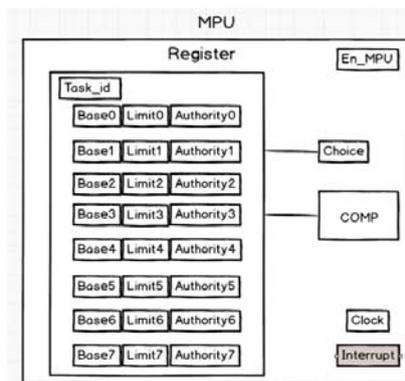


Figure 18. MPU block diagram2

As illustrated, internal components of MPU are registers. The task_id register shows the running task, so that MPU knows which task is running. A total of eight sets of registers could set address segments for eight tasks at the same time. For example, when task_id equals 0, task0 is running. The base0, Limit0 and authority0 will be set for task0 (For the convenience of presentation, three registers are grouped together and named by group0). At the same time, all other sets of register for task0 will be closed, indicating that task0 can only access the same address with group0. If task0 wants to access another group, the MPU will block such attempt. Moreover, the choice register is used to operate more address with less register. The En_MPU register applied to open or close MPU. When En_MPU equals 1, MPU is open. When En_MPU equals 0, MPU is closed.

```

ENTITY mpu IS
  PORT (
    clk_i : in STD_LOGIC;
    clr_i  : in  STD_LOGIC;

    i_addr : in STD_LOGIC_VECTOR(9 DOWNTO 0);
    stb_rom_i : in STD_LOGIC;
    int_ins : out STD_LOGIC;

    d_dat : in STD_LOGIC_VECTOR(7 DOWNTO 0);
    d_addr : in STD_LOGIC_VECTOR(7 DOWNTO 0);
    d_rd_dat : out STD_LOGIC_VECTOR(7 DOWNTO 0);
    ram_addr_bus : in STD_LOGIC_VECTOR(11 DOWNTO 0);

    we_i : in STD_LOGIC;
    stb_i : in STD_LOGIC;
    ack_o : out STD_LOGIC;

    stb_ram_i : in STD_LOGIC;
    stb_real_ram_i : out STD_LOGIC;

    int_flag : in STD_LOGIC;

    int_o : out STD_LOGIC
  );
END mpu;

```

Figure 19. Port definition of MPU

Above figure shows hardware MPU code in VHDL. All VHDL codes are written with ISE. Besides, it presents ports of MPU, which are used to connect with CPU. To be more specific, following table lists the function of ports.

Table 3. Functions of ports

i_adr	Instruction address
Stb_rom_i	Command chip selection
Int_ins (Design for ROM)	When instruction range is out of range, it is generated high level
D_dat	Externally written data
D_adr	External incoming address
D_rd_dat	Internal outgoing data (for reading)
Ram_addr_bus	Address of RAM
We_i	Write signal (write operation generate high)
Stb_i	Chip select signal
Stb_ram_i	Chip select signal to access RAM
Stb_real_ram_i	MPU Chip select signal (If it generates low level, MPU block access to RAM)

Through these interfaces, PicoBlaze's data bus and address bus are connected to the MPU to control the MPU work.

```

signal base0,base1,base2,base3,base4,base5,base6,base7 : STD_LOGIC_VECTOR(11 DOWNTO 0);
signal limit0,limit1,limit2,limit3,limit4,limit5,limit6,limit7 : STD_LOGIC_VECTOR(11 DOWNTO 0);
signal auth0,auth1,auth2,auth3,auth4,auth5,auth6,auth7 : STD_LOGIC_VECTOR(1 DOWNTO 0);
signal task_id: STD_LOGIC_VECTOR (2 downto 0);
signal en_mpu : STD_LOGIC;
signal choice : STD_LOGIC_VECTOR (6 downto 0);
signal en : STD_LOGIC;
signal en_check : STD_LOGIC;
signal rule, rule_seg, rule0, rule1, rule2, rule3, rule4, rule5, rule6, rule7 : STD_LOGIC;
BEGIN

```

Figure 20. Register declaration

The figure above illustrates all registers set in MPU. The En_MPU signal is used to control the open/close of MPU like a switch. The selection signal is multiplex register, which can operate more address with less registers. Moreover, the signal rule is used to judge logical selection. If the rule equals 1, the access is proved to pass all logical checks of MPU. If the rule equals 0, MPU will block this access to RAM.

```

stb_real_ram_i <= ((not en_mpu) or rule) and stb_ram_i;

process(ram_addr_bus, we_i, base0, limit0, auth0)
begin
if (conv_integer(ram_addr_bus) > conv_integer(base0) or conv_integer(ram_addr_bus) = conv_integer(base0)
and conv_integer(ram_addr_bus)<(conv_integer(limit0) + conv_integer(base0))
and ((we_i = '0' and auth0(0) = '1') or (we_i = '1' and auth0(1) = '1')) then
rule0 <= '1';
else
rule0 <= '0';
end if;
end process;

```

Figure 21. Register set for task0

Figure 21 shows the example of task0. When both rule and stb_ram_i equal 1, the stb_real_ram_i will generate 1, indicating MPU allows the access to RAM. In other words, when there is memory access, the stb_ram_i will generate 1. The MPU will check address of this access. If the address is valid, the rule will equal 1 and stb_real_ram_i will generate high level by MPU. If invalid, the rule will equal 0 and stb_real_ram_i will generate low level by MPU, which means that MPU blocks this access.

After introducing different register functions, how processor controls MPU and writes data to MPU register will be explored then. As mentioned before, CPU is connected to MPU through parallel buses (address bus and data bus). According to core address decoder, only four different addresses from 11011000 to 11011011 (00 01 10 11) are available to control MPU. Different addresses are assigned to different registers, thus the address decoder decodes address information sent by CPU and generates chip select signal, which can be identified by MPU. In addition, MPU will load different address into different registers.

```

elseif clk_i = '1' and clk_i'event then
  if en = '1' then
    case conv_integer(d_adr(1 downto 0)) IS
      when 0 =>
        en_mpu <= d_dat(0);
      when 1 =>
        task_id <= d_dat(2 downto 0);
      when 2 =>
        choice <= d_dat(6 downto 0);
      when others => --3
        if choice(6) = '1' then
          case conv_integer(choice(4 downto 0)) is
            when 0 => ins_base0(9 downto 8) <= d_dat(1 downto 0);
            when 1 => ins_base0(7 downto 0) <= d_dat;
            when 2 => ins_limit0(10 downto 8) <= d_dat(2 downto 0);
            when 3 => ins_limit0(7 downto 0) <= d_dat;
          end case;
        end if;
    end case;
  end if;
end if;

```

Figure 22. Address multiplexing

Since MPU has many registers, there remains a problem on how to use four addresses to control all registers. To solve that, a register namely choice is used to realize address multiplexing. As showing in the figure, the MPU uses two lowest addresses to distinguish four addresses transported via parallel buses. To specify, the first address 11011000 is used to set En_MPU register. The second address 11011001 is used to set task_id register. The third address 11011010 is used to set choice register. The fourth address 11011011 is used to set base and limit registers according to the value of choice register. For example, the choice (6) equals 1. When choice equals 0, the zero bit of data will be written into the eighth bit of ins_base0 register while the first bit will be written into ninth bit of ins_base0. The value of choice is [] [1] [0] [0] [0] [0] [0]. When choice equals 1, the value of choice is [] [1] [0] [0] [0] [0] [1], and all eight bits data will be written into remaining 8 bits of ins_base0 register.

Software Design

The software part of the project is to test basic functions of MPU. In that case, it will write code with OpenPICIDE, by which the software can convert assembler to VHDL. Moreover, it can load instructions that can be recognized by PicoBlaze into the ROM file, from which the processor can read instructions. Additionally, the communication protocol is to use assembly instruction set.

```

start: Load S0, 0x10      ; S0 ← 0x10
      Load S1, 0x10      ; S1 ← 0x10
      Out S0, (S1)       ; Mem[S1] ← S0
      Load S0, 0x00      ; S0 ← 0x00
      In S0, (S1)        ; S0 ← Mem[S1]
loop:  Jump loop        ; trap, stop program

```

Figure 23. Assembly instruction

Generally, three main assembler instructions are used to load data into register. The first operand of **load** instruction must specify the register to be loaded as register 's' followed by a hexadecimal digit. Next, the second operand specifies a second register value in a similar way. As Figure 23 shows, the value 0x10 is loaded into register S0 through load instruction. The **out** instruction enables the contents of any registers transferring to logic external of PicoBlaze. Moreover, the port address can be defined by a constant value. Each out instruction specifies the source register as 's' followed by a hexadecimal digit. After that, it further specifies the output port address by using a register value in a similar way. Seen from the figure above, the value of register S0 0x10 is transferred to memory address 0x10. The **In** instruction enables data values external to PicoBlaze transferring into any one of internal registers. This instruction is contrary to the out command. The value 0x10 of memory address S1 is transferred into register s0 through **In** instruction. Thereby, the final value of register S0 is 0x10.

Test methods and code

Test 1

```

start:
load S0, 0x00 ;set S0 to 00

;close MPU
out S0, en_mpu
out S0, en_each_mpu_seg

;read registers/test
;en MPU (01)
in S2, en_mpu ;S2=01

;set base0 to 000
load S1, 0x00
out S1, choice_mpu_reg
out S0, set_mpu_reg
load S1, 0x01
out S1, choice_mpu_reg
out S0, set_mpu_reg

;task_id (01)
in S2, task_id ;S2=01

;base0 (000)
load S1, 0x00
out S1, choice_mpu_reg
in S2, set_mpu_reg ;S2=00
load S1, 0x01
out S1, choice_mpu_reg
in S2, set_mpu_reg ;S2=00

;set limit0 to 100
load S1, 0x02
out S1, choice_mpu_reg
load S1, 0x01
out S1, set_mpu_reg
load S1, 0x03
out S1, choice_mpu_reg
out S0, set_mpu_reg

;limit0 (100)
load S1, 0x02
out S1, choice_mpu_reg
in S2, set_mpu_reg ;S2=01
load S1, 0x03
out S1, choice_mpu_reg
in S2, set_mpu_reg ;S2=00

;set auth0 to 3
load S1, 0x20
out S1, choice_mpu_reg
load S1, 0x03
out S1, set_mpu_reg

;auth0 (3)
load S1, 0x20
out S1, choice_mpu_reg
in S2, set_mpu_reg ;S2=03

```

Figure 24. Set address with register for task0 and test MPU register

As Figure 24 shows, the first test aims to test the value that can be loaded into register and the read value from the register. In the test, each task is limited by one register. For example, task0 is limited by base0, limit0 and authority0. The right tests whether the value can be read from MPU to register two.

Test 2

Test 2 aims to test block function. At first, a register is used to show the value of the task, indicating that it enables MPU knowing which task is running. For example, a value of 0 means the task0 is running. The register base0, limit0, authority0 (Read/Write) should be opened for task0. At the same time, bases from base1 to base7, limits from limit1 to limit7, and authorities from authority1 to authority7 should all be closed. Task0 can only access base0 and limit0. If the address is valid, MPU will release strobe signal to allow data written into RAM. If task0 tries to access other base or limits registers, MPU will cut off the strobe signal to stop any writing operation. In this way, MPU provide memory protection for RAM in a way avoiding wrong data written into RAM.

```

;set base0 to 0x000
load S1, 0x00
out S1, choice_mpu_reg
out S0, set_mpu_reg
load S1, 0x01
out S1, choice_mpu_reg
out S0, set_mpu_reg

;set limit0 to 0x040
load S1, 0x02
out S1, choice_mpu_reg
load S1, 0x00
out S1, set_mpu_reg
load S1, 0x03
out S1, choice_mpu_reg
load S1, 0x40
out S1, set_mpu_reg

;set auth0 to 3(rw)
load S1, 0x20
out S1, choice_mpu_reg
load S1, 0x03
out S1, set_mpu_reg

;set base1 to 0x040
load S1, 0x04
out S1, choice_mpu_reg
out S0, set_mpu_reg
load S1, 0x05
out S1, choice_mpu_reg
load S1, 0x40
out S1, set_mpu_reg

;set limit1 to 0x040
load S1, 0x06
out S1, choice_mpu_reg
out S0, set_mpu_reg
load S1, 0x07
out S1, choice_mpu_reg
load S1, 0x40
out S1, set_mpu_reg

;set auth1 to 1(read only)
load S1, 0x21
out S1, choice_mpu_reg
load S1, 0x01
out S1, set_mpu_reg

```

Figure 25. Set address for task0 and task1

The block function test is as shown in the left side of Figure 25, the base address is set as 0x000 while limit address is set as 0x040. The effective address range set for task 0 is from 0x000 to 0x03f. Besides, the authority indicates functions in reading and writing. While the right side is to set address for task1. The base1 sets address 0x040 and limit1 sets 0x040. Therefore, the effective address range set for task1 is from 0x040 to 0x07f. However, the authority only sets read function, which means reading operation is allowed within the valid address range. Writing operations are excluded. In addition, with regards to testing coverage, all addresses can be tested by looping. The order of testing starts with performing a full address read test on task 0, and followed by a full address write test of task 0. After that, it performs a full address read test on task 1, and continues with a full address write test of task 1.

```

read_all_ram:
    load S1, 0x00
    load S2, 0x00
    out S1, ram_high_addr
pos1:
    in S2, (S1)
    comp S1, 0x7f
    jump Z, ret_read_all_ram
    add S1, 0x01
    jump pos1
ret_read_all_ram:
    load SA, 0x0B :*****
    ret

*****
;set all the ram to SB (write test)
*****
write_all_ram:
    load S1, 0x00
    out S1, ram_high_addr
pos2:
    out SB, (S1)
    comp S1, 0x7f
    jump Z, ret_write_all_ram
    add S1, 0x01
    jump pos2
ret_write_all_ram:
    load SA, 0x0C :*****
    ret
    
```

Figure 26. Test of read and write operation

The former is read test while the later is write test. Apparently, adding instruction can perform overlay calculations to accumulate all addresses.

Test 3

```

; -----
; INTERRUPT SERVICE ROUTINE
; -----

ORG 0x3FD
int_routine:
    add SC, 0x01
    reti enable
    jump int_routine

ORG 0x100
task0:
    ;set task_id to 0x01
    out S0, task_id

    ;open MPU
    load S1, 0x01
    out S1, en_mpu

    call task1

    load S1, 0xA0 ;The signal of top_level/int_ins goes high

    ;close MPU
    out S0, en_mpu

loop:
    load S0, 0xED
    jump loop

ORG 0x200
task1:
    load S1, 0xB0 ;The signal of top_level/int_ins goes high
    
```

Figure 27. Test the interrupt and ROM protection

The third test is to interrupt test code. When MPU generates a block, it will immediately call this part of the interrupt instruction to issue an interrupt signal. From the aspect of improving the follow-up system, ISR (Interrupt Service Routine) spares certain time for the system to call instructions in order to handle blocked tasks. The right side shows the last test is for ROM protection. Task0 can execute instructions from 0x100 to 0x1ff and task1 can only execute instructions from 0x200 to 0x2ff. Once there are instructions indicating the address is out of range, signal int_ins will be high.

RESULT AND EVALUATION

The results are presented by waveform picture that is simulated in ISE. It enables monitoring relevant signals for different clock cycles to verify if the design has met requirements of the project.

Test 1 Simulation Results

The first test is concerning the basic function of register. It only proves that the register can be loaded and read. In other words, the value of register update along with the clock cycle.

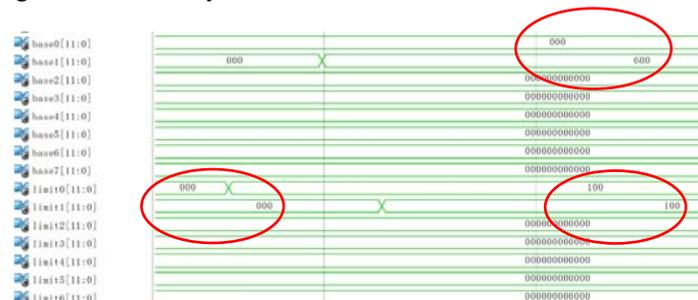


Figure 28. Waveform of test register

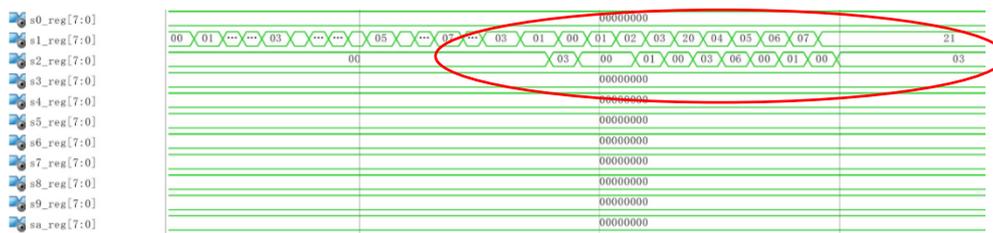


Figure 29. Waveform of test register

Figures above pictorially show that the value updates, proving that register of MPU can load and read value normally.

Test 2 Simulation Result

For the convenience of monitoring, the results of Test 2 and Test 3 are combined to present in the same waveform.



Figure 30. Waveform of task0 read operation

The En_MPU signal is the enabler signal of MPU, working like a switch of the MPU. When the signal is high, MPU is turned on and starts to work. When the signal is low, MPU is off. Moreover, CPU generates the stb_ram_i signal, indicating that CPU tries to write data into RAM. The stb_real_ram_i signal is generated by MPU. When MPU checks the valid address assigned by the task access, the stb_real_ram_i signal will be either in high level or low level.

Earlier in the hardware design section, MPU uses logic AND gate to do logical judgment. Both stb_ram_i signal and stb_real_ram_i signal are generated in high level. The strobe signal would pass MPU while CPU could write data into RAM. Furthermore, the task_id signal shows running status of a task. If the task_id equals 0, task0 is running at present. Additionally, The we_i signal shows current type of operation. For example, high we_i signal indicates current operation is writing. When it is low, the current operation is reading.

The figure above shows that MPU is open to test task0. The valid address for task0 is from 0x000 to 0x03f. At the beginning, the address is 0x000 and task0 execute a reading operation in the effective address range, thus the we_i signal is low. In addition, both stb_ram_i signal and stb_real_ram_i signal are high, proving that MPU checks access and confirms its validity. The strobe signal has passed the MPU.



Figure 31. Waveform of task0 blocked

Each address is tested by looping. When the address is 0x040 and not valid for task0, the MPU generates low signal stb_real_ram_i. It proves that MPU has executed block function. After that, the int_mpu signal is generated to be high.

Moreover, the register SC is used to count the number of interrupts. Whenever an interrupt is triggered by a block, the value of SC will be incremented by one. As it is shown in the figure, after first interrupt signal, the value of SC is updated to 1.



Figure 32. Waveform of task0 blocked

Until the test reaches address 0x07f, the read test for task0 is complete. The valid address for task0 is from 0x000 to 0x03f. Moreover, the address from 0x040 to 0x07f is set for task1. In this way, all read operations executed between 0x040 and 0x07f are blocked by MPU to generated interrupt signals. Therefore, the read test for task0 is correct, which proves MPU working normally.



Figure 33. Waveform of task0 write operation

The above test is concerning the write operation for task0. Writing operation starts from the initial address at 0x000. The we_i signal generates high level from the beginning, indicating that it is executing writing operation. Until the address 0x03f is valid, MPU always allows the access to pass. Both stb_ram_i signal and stb_real_ram_i signal are high.

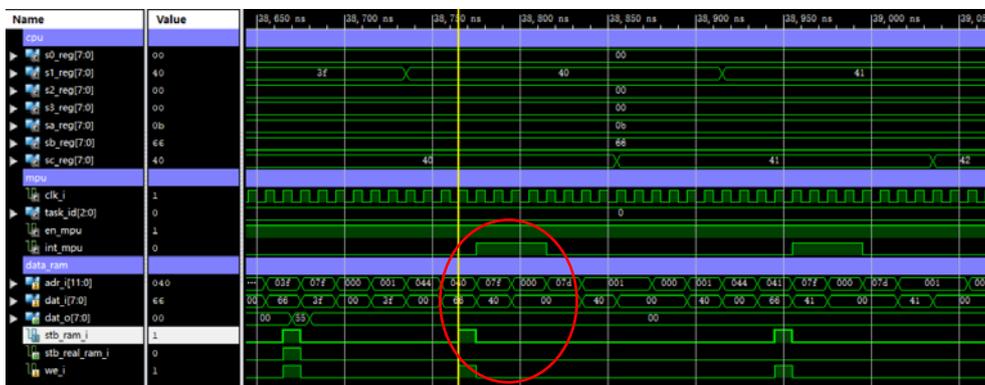


Figure 34. Waveform of task0 blocked

For task 0, starting from address 0x040 is invalid. So, MPU blocks all writing operation from 0x040 to 0x07f. The signal stb_real_ram_i is generated at a low level. After each block, MPU also triggers the interrupt. Moreover, task0 is to test reading and writing operations for all address. As far as the test results are concerned, MPU blocks the normal detection address and

triggers the interrupt. The following test is for task1. However, task1 is set only with read authority, which means that it can only execute reading operations within effective address and could execute any writing operations.



Figure 35. Waveform of task1 blocked

Seen from the test sequence, the primary test is still the read testing for task1. The valid address of task1 is from 0x040 to 0x07f. It can be acquired from the figure that both we_i signal and the stb_real_ram_i signals are low. The reading operation is blocked and triggered in interruptions by MPU. Additionally, the task_id equals 1, proving that task1 is currently running.



Figure 36. Waveform of task1 blocked

From 0x040, MPU does not block task 1 to execute reading operations. Both stb_ram_i signal and stb_real_ram_i signal are generated at a high level.



Figure 37. Waveform of task1 authority test

The above test is to test writing operation of task1. As mentioned, task1 only has read authority, thus it could not execute any writing operations. From 0x000, the we_i signal is generated at a high level, indicating that task1 executes writing operation. The stb_real_ram_i is generated at a low level, indicating that MPU blocks access and triggers the interrupt.

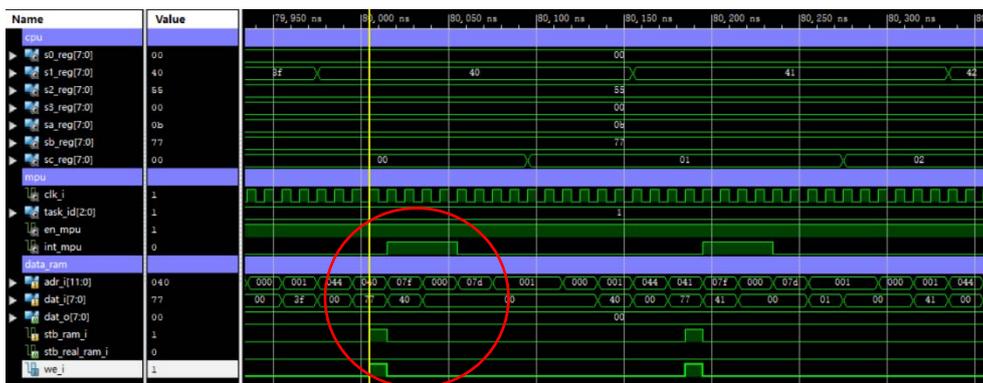


Figure 38. Waveform of task1 blocked

Even it starts from the address 0x040, MPU still blocks the write operations of task1. MPU always triggers an interrupt signal after blocking.

Test 3 Simulation Result

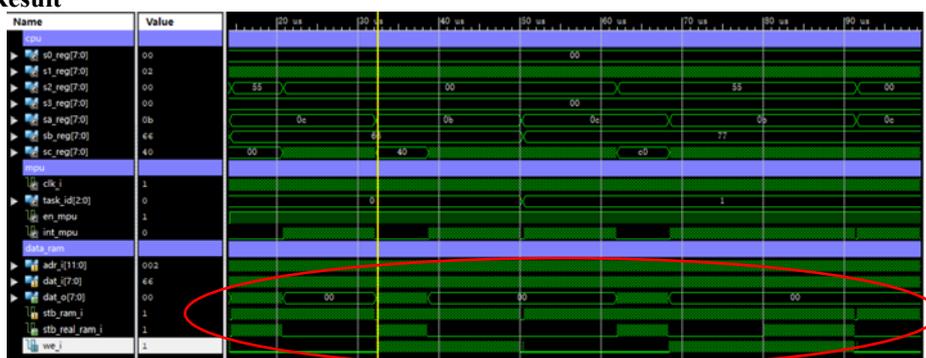


Figure 39. Waveform of whole block test

Such figure provides an overview of whole block test. Test result has confirmed that MPU can implement memory protection function properly. When it detects an out-of-range address access, it could block the access and trigger an interrupt signal. From this respect, it basically achieves the expected function of memory protection. Following test is for ROM protection testing. As mentioned, ROM could not perform any writing operations. Instead, it only supports reading operation. So, MPU can be simplified when comparing to RAM. The blocking function is removed while the detection address function is retained. When MPU detects an out-of-range address, it will send a high-level signal int_ins.

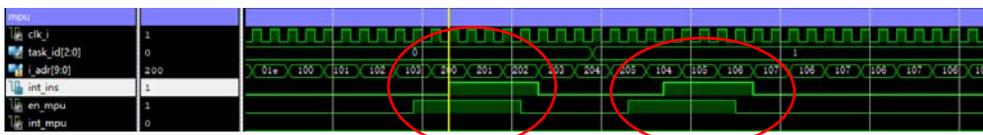


Figure 40. Waveform of ROM test

Task0 executes instruction at address 0x200. MPU generates int_ins at a high level. The task1 execute instruction at address 0x104 and MPU generates int_ins at a high level. Moreover, MPU of the ROM does not link with interrupt. The reason is that the interrupt signal actually lags behind the clock cycle of the instruction access. That is to say, when MPU gives out interrupt signal, the instruction that crosses the boundary has already completed the read operation in the ROM. In this case, interrupts would waste the clock cycle of the system. In addition, the interrupt signal is to call the interrupt service routine at the system level.

CONCLUSION

In general, the proposed embedded strategy works out successfully. The hardware MPU is designed to protect memory. As a fact, original system design did not involve a complete memory protection mechanism. Misreading and miswriting of code could easily lead to address crossing. Once address crossing occurs, there will be inevitable unknown errors to the system. To make a complete and safe system, complete memory protection mechanism is desired. The test result has succeeded in implementing the expected memory protecting function. This design meets both operational capabilities of CPU and required functions at the lowest cost.

The key point of this design is in hardware. The MPU checks the address of the running task while supporting the multitasking operation. Once the invalid address is figured out, the access signal is immediately blocked to prevent the erroneous data from writing into the memory.

This research is based on RTOS designed by Adam (Matthews, 2018). The aim of this research is to make such OS better by adding new functions. More importantly, this research fills the gap since there is currently no complete memory protection available for operating systems based on PicoBlaze soft-controller. With respects to design requirements, since the system is a small-embedded operating system and many protection schemes are not capable to be applied in the system, current design is considered as the best solution for such system in all aspects. In addition, prior to the research, there has been a lack of software system with memory protection function designed based on PicoBlaze. Therefore, the research made certain contributions to the expansion of the PicoBlaze software system. However, the researcher failed to achieve full OS functions. In that sense, OS functions could a researching field in future work.

Admittedly, the research only innovated in the hardware aspect. However, standing from entire software system, the research has not been completed. Full OS functionality needs to be supplemented in the software section. Moreover, the most important field is how to add MPU to the system. After creating tasks, the system assigns them different private address segments. MPU will accept these settings and start working. Every task that runs from the ready list and goes to the run list must be checked by MPU. Once an out-of-range address is found, the access is blocked and the interrupt signal is triggered and processed by ISR (Interrupt Service Process). In addition, designing the waiting list is also necessary. Tasks that have finished running or been interrupted would be placed in this area waiting for the system to process.

Another area that requires to be extended is to add some memory protection features when communicating between tasks. For example, when communicating, the system must allocate them a shared memory. However, the problem is that two tasks could not access the shared memory area at the same time, which might cause system error. Therefore, a protection mechanism is expected to compensate the limitation. When a task is using shared memory, the second task is not allowed to access until the current task finishes running and leaves shared memory area. Finally, future researchers can choose other types of soft-controllers to construct more complex systems.

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Digital Business Strategy: An Empirical Analysis of Mission statement content and Financial Performance

(Full Paper)

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ABSTRACT

The mission statement identifies the fundamental *raison d'être* of an organization. However, developing such a document seems to be quite difficult, since most businesses end up crafting a meaningless text. Indeed, it is crucial to evaluate the content of the mission statement. The purpose of this chapter is to examine the relationship between the components of mission statement and financial performance in e-businesses. This was accomplished through one way ANOVA and t-test analysis. The findings of the research indicated that there isn't a positive relationship between the mission statement and the performance of digital businesses. In addition, it was revealed that only one component had a positive and statistically significant correlation with a financial index. All other correlations were weak and statistically insignificant.

Keywords: mission statement, organizational performance, financial performance, e-business management, e-business strategy.

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INTRODUCTION

The mission statement identifies the fundamental *raison d'être* of an organization. The main reason for developing an effective mission statement is not the economic benefits, but its guidance for developing new strategies and taking everyday business decisions. Furthermore, mission statement is an effective and easy way for an organization to communicate with its internal and external environment (Braun *et al.*, 2012; Ireland *et al.*, 1992; Lin *et al.*, 2016). This is achieved by including it in the annual report and on the official website of the organization. As one of the most widely used strategic management tools in the world, mission statement promotes the organization's culture and ethos, resulting in motivating and guiding the employees' behavior (Babnik *et al.*, 2014; Swales *et al.*, 1995). Also, through the mission an organization can express its transparency public (Craig *et al.*, 2016).

Although many researches have been devoted to the analysis and identification of the preferable content of mission statement (Bart *et al.*, 2001), there is a great deal of confusion about the components which are required to craft a proper mission (Bart, 1997; Dermol, 2012; Yazhou & Jian, 2011). Academics have not agreed regarding the appropriate content of the mission statements. Even if practitioners and academics emphasize its importance, there is inconsistency about the components that should be included in mission statements. Many components have been proposed, but it is not known which of them is beneficial for businesses. Moreover, the existing studies in this field have examined the content of mission statements in traditional businesses and not in digital firms. Thus, it is necessary to study and evaluate the content of the mission statements. Therefore, this paper attempts to fill this gap. The purpose of this paper is to examine the relationship between mission statement and financial performance in e-businesses. This was accomplished through one way ANOVA and t-test analysis.

The rest of the paper is organized as follows: Section 2 presents the theoretical framework of the components of mission statements. Section 3 presents the methodology used for the study. Section 4 provides the results of data analysis. Finally, conclusion, and recommendations for future research are provided in the last section of the paper.

THEORETICAL BACKGROUND

Although many researches have been devoted to the analysis and identification of the preferable content of mission statement (Bart *et al.*, 2001), there is a great deal of confusion about the components which are required to craft a proper mission (Bart, 1997; Delimpasis & Kitsios, 2018; Dermol, 2012; Yazhou & Jian, 2011). Table 1 summarizes the components of mission statements based on the existing literature.

Pearce and David (1987) proposed a set of mission statement components. These components are: "target customers / markets", "products or services", "geographic domain", "technology", "concern for survival, growth and profitability", "philosophy", "self-concept" and "public image". David (1989) amended this list of 8 components, adding "concern for employees" as a component of a great value. Many re-searchers consider either these 8 components or the expanded set of 9 components as appropriate for the mission statement. Lin and Ryan (2016) added "safety" to the previous set. Rarick and Vitton (1995) and Sufi and Lyons (2003) considered that the main components of a mission are: "concern for public image", "concern for quality", "commitment to survival, growth and profitability", "customer and market identification", "product and service identification", "statement of philosophy", and "differentiation from competition".

Reviewing the pre-existing literature, Bart (1996) used in his research the most of-ten referred components. These components were: “identification of the relevant stakeholders”, “specification general / corporate non-quantitative goals”, “definition of success”, “definition of products/business”, “definition of markets/customers”, “identification of the firm’s competitive strategy/posture”, and “identification of important behaviour standards”. Later, Bart Baetz (1998) and Bart et al., (2001) focused on the economic components of mission statements.

In contrast, Hirota *et al.* (2010) used 2 groups to diversify their components, which were a) company values / philosophies / objectives and b) norms and patterns of behaviour. The first group includes the following subcomponents: contributing to society, providing a valuable workplace, concern for customers, commitment to a high-quality product, commitment to higher technology, environmental care, concern for growth of the company, employees’ skills, respect for various aspects of employees’ life, concern for local community, concern for performance, concern for the interests of shareholders. The second group includes the subcomponents: innovation and originality, conscientiousness and cordiality on the job, rise to challenges, cooperation, harmony, fairness and transparency. Table 1 presents the components of a mission statement based on the existing literature.

Table 1: Components of Mission Statement

Components	Pearce and David (1987)	David (1989)	Rarick and Vitton (1995)	Bart (1996)	Bart (1997)	Bart Baetz (1998)	Bart, Bontis and Taggar (2001)	Sufi and Lyons (2003)	Bartkus <i>et al.</i> (2006)	Hirota <i>et al.</i> (2010)	Yazhou and Jian (2011)	Zhang <i>et al.</i> (2015)	Lin and Ryan (2016)	Pandey <i>et al.</i> (2017)
Purpose of the Organization					X	X					X			
Values / Philosophy	X	X	X		X	X		X	X		X		X	
Distinctive Competence			X		X		X	X	X					
Desired Competitive Position					X		X							
Identification of the Firm’s Competitive Strategy / Posture				X	X	X	X							
Relevant / Critical Stakeholders Identified				X	X									
Identification of Important Behaviour Standards				X	X						X			
General Corporate Aims / Goals				X	X		X				X			
One Clear and Compelling Goal					X									
Specific Financial Objectives					X	X			X					
Specific Non-financial Objectives					X		X							
Definition of the Business					X			X						
Specific Customers / Markets Served			X		X			X						
Specific Products / Services Offered	X	X		X	X								X	
Self-concept	X	X			X								X	

Desired Public Image	X	X			X			X				X	
Identification of the Business' Location	X	X			X				X		X		X
Definition of Technology	X	X			X					X			X
Concern for Survival, Growth and Profitability	X	X	X		X			X		X	X		X
Satisfaction of Customers					X			X		X			X
Concern for Employees		X			X		X	X		X	X		X
Concern for Suppliers					X								
Concern for Society					X				X	X	X		
Concern for Shareholders					X					X	X		
Statement of Vision					X								
Target Customers / Markets	X	X	X	X									
Concern for Quality			X					X		X			X
Definition of Success				X									
Current State of the Business								X					
Future Orientation									X				
Pursuit of Excellence									X		X		
Valuable Workplace										X			
Environmental Care										X			
Innovation and Originality										X			
Conscientiousness and Cordiality										X			
Rise to Challenges										X			
Cooperation										X			X
Harmony										X			
Fairness										X			
Transparency										X			
Clarity												X	
Activism Tone												X	
Focus												X	
Aggression													X
Accomplishment													X
Communication													X
Cognitive Terms													X
Motion													X
Passivity													X
Embellishment													X
Centrality													X
Rapport													X
Diversity													X
Exclusion													X
Liberation													X

Even though the relationship between mission statement and organizational performance has been studied for almost 3 decades, there is only little empirical studies (Duygulu *et al.*, 2016; Kirk & Nolan, 2010) and the findings of these studies are ambiguous and inconsistent (Dermol, 2012; Desmidt, Prinzie & Decramer, 2011; Dharmadasa *et al.*, 2012; Stallworth Williams, 2014). One of the studies, which investigated the relationship between mission statement and business performance, failed to attribute a higher performance to the 75 companies that included the mission statement in their strategy compared to the 106 who did not include it (David, 1989). Similar findings presented Dharmadasa *et al.* (2012) in their survey where 74 companies in Sri Lanka included a mission statement but 113 companies did not include it. Even more surprisingly, a more recent survey of 3034 small and medium-sized enterprises in Turkey showed that the overall performance of businesses without mission statement was found to be slightly higher than businesses with one (Duygulu *et al.*, 2016). The research conducted by Rarick and Vitton (1995) showed that companies with a mission statement had an average return on stockholder

equity 16.1%, while those without a mission statement had 9.7%. Bart Baetz (1998) concluded that there was no difference in the return on assets comparing 117 and 19 companies that had and did not have a mission statement respectively. Dermol (2012) conducted a survey in 216 Slovenian businesses with a mission statement and in 169 without mission statement and he found that there was a statistically significant difference only for the performance variable “value added per worker”. All other relationships between the existence of a mission statement and the other performance measures of the companies, i.e. return on assets, return on equity and average value of annual revenue increases, were tenuous and statistically insignificant.

Another research that studies the impact of mission statement on the non-financial performance of high-tech companies, which is expressed as the performance of innovation, found that a mission statement positively affects the performance of innovation, which in turn can improve firm performance (Zhang *et al.*, 2015). According to Bart (1997), the mission statement of 13 (purpose / raison d’etre, values / philosophy, competitive strategy, general corporate goals, self-concept, desired public image, concern to survival, concern for customers, concern for employees, concern for suppliers, concern for society, concern for shareholders, vision statement) of the 25 components positively influenced the performance of enterprises, as opposed to 3 (identification of stakeholders, non-financial objectives, business definition) of the 25 components, where performance was negatively affected by the mission statement. Similar results presented by Sufi and Lyons (2003). In their research, although no correlation was found between the mission statements and the return on equity and the net profit margin, the mission statements showed to be positively related to the annual turnover. Based on these studies, the following hypotheses are presented:

- H1a: There is a positive correlation between mission statement and gross profit margin in digital businesses.
- H1b: There is a positive correlation between mission statement and net profit margin in digital businesses.
- H2a: There is a positive correlation between mission statement and asset turnover in digital businesses.
- H2b: There is a positive correlation between mission statement and equity turnover in digital businesses.
- H2c: There is a positive correlation between mission statement and liability turnover in digital businesses.
- H3a: There is a positive correlation between mission statement and return on equity in digital businesses.
- H3b: There is a positive correlation between mission statement and return on assets in digital businesses.
- H4: There is a positive correlation between mission statement and solvency ratio in digital businesses.
- H5a: There is a positive correlation between the components of mission statement and gross profit margin in digital businesses.
- H5b: There is a positive correlation between the components of mission statement and net profit margin in digital businesses.
- H6a: There is a positive correlation between the components of mission statement and asset turnover in digital businesses.
- H6b: There is a positive correlation between the components of mission statement and equity turnover in digital businesses.
- H6c: There is a positive correlation between the components of mission statement and liability turnover in digital businesses.
- H7a: There is a positive correlation between the components of mission statement and return on equity in digital businesses.
- H7b: There is a positive correlation between the components of mission statement and return on assets in digital businesses.
- H8: There is a positive correlation between the components of between mission statement and solvency ratio in digital businesses.

Hypotheses 1-4 examine if businesses that have stated mission statement have better profit rather than businesses that did not have mission statement. Especially, hypotheses 5-8 examine the relationship between the components of mission statement and the indices of financial performance only for businesses that have mission statement.

METHODOLOGY

A field of survey for managers in e-businesses was developed. The questionnaire developed for the purpose of this study consists of two major parts. The first part investigates managers’ profile. This part includes questions regarding managers’ gender (Male–Female), managers’ age (18–25, 36–45, 46–55, over 56), and managers’ educational level (secondary education, higher education, Postgraduate/MSc/PhD). The second part refers to the components of mission statement named: the specification of target customer, the identification of principal products/ services, the specification of geographic domain, the identification of core technologies, the expression of commitment to survival, growth, and profitability, the specification of key elements in the company philosophy, the identification of the company self-concept, the identification of the firm's desired public image, concern for employees and concern for quality of products or services (David, 2011). The instrument used 3 point Likert scale to operationalize ten constructs of mission statement. Finally, the third part of the questionnaire includes variables regarding to financial performance; Gross profit margin, Net profit margin, Asset turnover, Equity turnover, Liability turnover, ROE - Return On Equity, ROA - Return On Assets and Solvency ratio (Kamariotou & Kitsios, 2017; Kamariotou *et al.*, 2018; Kitsios & Grigoroudis, 2014; Kitsios & Kamariotou, 2019a; b; 2018; 2017; Kitsios *et al.*, 2015; 2009). One way ANOVA and t-test analysis were implemented in order to examine the hypotheses and compare the results between the businesses that have a mission statement with those that do not have.

The research was done in Greek e-businesses. Companies were selected from the database of Greek e-Commerce Association (GR.EC.A.). The database includes 288 companies. Websites were frequently used for accessing to business mission statements and performance indices. If companies’ websites did not mention financial indices then Hellastat database or the portal of General Commercial Registry was accessed. 137 companies have published on their website their mission statement. The questionnaire was sent to these 137 companies and a total of 68 managers completed the questionnaire. The response rate was 23.61%.

RESULT

It is noted that businesses with a mission statement have a greater gross profit margin of these without a mission statement. However, their difference is not statistically significant, since $p = 0.549$. H1a is therefore rejected. Also, companies with no mission statement not only have a greater net profit margin than those with a mission statement, but their difference is also statistically significant, since $p = 0.037$. H1b is accepted. Moreover, it is found that although the companies with a mission statement have greater equity turnover than those without a mission statement the correlation coefficient $p = 0.572$, so the difference is not statistically significant resulting in the rejection of H2b. On the other hand, asset turnover and liability turnover are greater in firms without a mission statement. However, in none of the 2 cases their difference was statistically significant, since the p values were 0.264 and 0.101 respectively. Thus H2a and H2c are rejected. It is discovered that return on equity and return on assets were greater in enterprises without a mission statement than those with a mission statement, but there is no significant statistical difference, since in the first $p = 0.234$, therefore, H3a is rejected, and in the second with $p = 0.094$, H3b is also rejected. Last but not least, it turns out that solvency ratio of companies without a mission statement was greater than those with a mission statement. However, the significance was not statistically significant, because $p = 0.240$. Thus, H4 is rejected. Table 2 presents the mean of 8 financial indices for businesses that have mission statement and for those that do not have.

Table 2: Difference in performance depending on mission statement

Financial indices	Mission Statement Mean	Non Mission Statement Mean	Significance
Gross Profit Margin	71.04	66.99	0.549
Net Profit Margin	61.86	76.04	0.037
Asset Turnover	65.18	72.76	0.264
Equity Turnover	56.20	52.80	0.572
Liability Turnover	62.43	73.49	0.101
Return On Equity	50.33	57.47	0.234
Return On Assets	63.28	74.64	0.094
Solvency Ratio	64.53	72.47	0.240

Due to the abnormal distribution, the Kruskal-Wallis test was used to compare the mean values in each group of components. If a difference in performance is found to be statistically significant, the non-parametric Mann-Whitney U test method is used per pairs of components to find out in which group the difference is statistically significant. In each one of the following tables (Tables 3-6) the relationship between the 3 groups of components (poor, vague, specific) with each performance metric is presented. The 3 groups of components (poor, vague, specific) presents the 3 point Likert scale which was used in the questionnaire. Mean scores are calculated for each component of mission statement only for businesses that have mission statement.

Table 3: Profitability

Components	Gross Profit Margin			p	Net Profit Margin			p
	Poor	Vague	Specific		Poor	Vague	Specific	
Target Customers	39.37	28.64	34.20	0.303	37.84	37.29	31.57	0.452
Products / Services	29.75	27.08	37.36	0.194	40.50	35.08	33.32	0.633
Geographic Domain	33.42	25.33	37.86	0.494	36.19	15.33	33.82	0.206
Core Technologies	34.25	18.38	46.25	0.008	34.63	34.00	34.33	0.996
Commitment to Survival, Growth and Profitability	33.51	36.39	34.69	0.879	35.86	33.50	32.00	0.806
Philosophy	36.18	35.09	31.74	0.704	35.97	40.27	29.57	0.278
Self-concept	34.55	27.53	37.64	0.260	37.05	28.20	35.82	0.368
Public Image	34.54	37.67	33.45	0.947	33.78	52.33	33.18	0.278
Concern for Employees	36.49	35.22	26.17	0.270	34.85	34.56	33.08	0.962
Concern for Quality	33.50	40.73	32.89	0.518	35.74	40.18	28.74	0.263

According to Table 3, the “Products / Services”, “Geographic Domain”, “Core Technologies” and “Self-concept” components have been found to have a positive correlation with gross profit margin, but only “Core Technologies” was found to have a statistically significant difference due to $p = 0.008$. Indeed, by performing the Mann-Whitney U test between groups “poor” and “specific” and groups “vague” and “specific” the $p = 0.05$ and $p = 0.007$ respectively. So, it was found that there is positive and statistically significant difference in gross profit margin for the component “Core Technologies”. As a result, H5a is partially rejected. Also, it seems that none of the components have any positive correlation with net profit margin and all the differences in performance are not statistically significant. Thus, H5b is rejected.

Table 4: Turnover

Components	Asset Turnover			p	Equity Turnover			p	Liability Turnover			p
	Poor	Vague	Specific		Poor	Vague	Specific		Poor	Vague	Specific	
Target Customers	32.05	35.21	35.54	0.816	31.37	37.50	35.00	0.663	32.53	41.71	32.69	0.309
Products / Services	28.75	37.35	34.69	0.622	32.88	39.69	33.34	0.573	32.75	36.31	34.30	0.916
Geographic Domain	35.08	50.50	31.18	0.270	34.23	42.00	34.00	0.797	37.35	28.33	29.77	0.295
Core Technologies	35.67	31.88	31.58	0.752	35.71	34.50	29.67	0.639	33.90	34.75	36.75	0.904
Commitment to Survival, Growth and Profitability	38.18	34.06	24.65	0.105	37.78	29.61	31.92	0.310	37.70	34.06	26.00	0.184
Philosophy	36.74	29.82	33.43	0.572	37.79	27.55	32.96	0.294	36.88	30.18	33.04	0.565
Self-concept	33.65	36.40	34.15	0.911	32.90	32.87	36.21	0.786	34.15	32.67	35.55	0.893
Public Image	35.00	28.33	33.73	0.842	35.54	25.33	31.91	0.612	32.85	49.67	38.48	0.275
Concern for Employees	34.83	43.28	26.63	0.158	33.83	37.67	34.75	0.866	34.28	46.67	26.25	0.064
Concern for Quality	33.95	41.36	31.63	0.416	33.00	36.82	36.16	0.777	33.87	38.45	33.47	0.767

According to Table 4, it was revealed that only “Target Customers” has a positive relationship with asset turnover, but the difference between the 3 groups is not statistically significant. The same finding regards to the component “Self-concept” with financial index equity turnover. There is a positive but not statistically significant relationship between “Self-concept” and equity turnover. Moreover, the “Self-concept” and “Core Technologies” components have been found to have a positive correlation with turnover, but none of these relationships were found to be statistically significant. Consequently, the hypotheses H6a, H6b and H6c are rejected.

Table 5: Efficiency

Components	Return On Equity			p	Return On Assets			p
	Poor	Vague	Specific		Poor	Vague	Specific	
Target Customers	39.61	31.50	32.93	0.404	37.68	36.36	32.03	0.559
Products / Services	39.81	35.96	33.19	0.652	41.13	33.85	33.55	0.600
Geographic Domain	35.64	17.17	34.64	0.294	35.44	8.00	36.27	0.059
Core Technologies	35.23	29.13	35.17	0.715	33.69	33.38	38.50	0.742
Commitment to Survival, Growth and Profitability	36.82	31.42	32.15	0.568	35.81	31.06	35.54	0.689
Philosophy	38.38	32.23	29.85	0.255	36.88	37.18	29.70	0.358
Self-concept	38.20	28.57	34.95	0.355	36.45	26.27	37.06	0.187
Public Image	34.77	48.00	29.50	0.348	33.52	51.67	36.64	0.302
Concern for Employees	35.93	31.39	31.25	0.673	34.89	33.33	33.83	0.969
Concern for Quality	37.71	36.59	26.87	0.138	36.08	39.09	28.68	0.290

According to Table 5, it was found that there is no positive and statistically significant relationship between the 10 components and the financial index return on equity, resulting in the rejection of H7a. Also, the “Geographic Domain”, “Core Technologies” and “Self-concept” components have been found to have a positive correlation with efficiency, but none of these relationships were found to be statistically significant. So, H7b is rejected.

Table 6: Solvency

Components	Solvency Ratio		P	
	Poor	Vague	Specific	
Target Customers	32.47	42.79	32.29	0.213
Products / Services	38.25	32.00	34.55	0.780
Geographic Domain	37.74	7.67	31.82	0.029
Core Technologies	31.65	37.75	43.75	0.146
Commitment to Survival, Growth and Profitability	34.62	35.11	33.31	0.968
Philosophy	33.65	37.55	34.30	0.849
Self-concept	34.10	31.67	36.03	0.773
Public Image	32.39	55.67	39.09	0.098
Concern for Employees	35.17	34.78	31.67	0.860
Concern for Quality	33.87	33.09	36.58	0.859

According to Table 6, The “Core Technologies”, “Self-concept” and “Concern for Quality” components have been found to have a positive correlation with solvency ratio, but none of these relationships were found to be statistically significant. Hence, the hypothesis H7 is rejected.

On the other hand, it was found that there is a statistically significant difference at the groups of component “Geographic Domain” with $p = 0.029$. Nevertheless, by performing the Mann-Whitney U test, between groups “poor” and “vague” and groups “poor” and “specific” the $p = 0.015$ and $p = 0.220$ respectively. Even though, the difference in performance between groups “poor” and “vague” is statistically significant, the difference in performance between groups “poor” and “specific” is not statistically significant due to $p > 0.05$. Thus, it seems that the negative relationship between “Geographic Domain” and solvency ratio is weak.

CONCLUSION

The mission statement is a crucial part of strategic plans and increase businesses’ competitive advantage. However, it is still unknown what the appropriate content should be and how mission statements can be evaluated. The purpose of this paper was to evaluate the relationship between mission statement and financial performance in e-businesses. According to the literature, businesses that include the mission statement in their strategy perform more efficiently than businesses that operate without it (Amran, 2012; Rarick & Vitton, 1995). There were even researchers who managed to prove partially this relationship (Dermol, 2012). However, by performing the non-parametric method Mann-Whitney U test, contrary results were shown. Indeed, in one case, the mission statement had a negative and statistically significant correlation with the performance, in terms of the financial index net profit margin. Similar results have also been obtained from other researchers (David, 1989; Dharmadasa *et al.*, 2012; Duygulu *et al.*, 2016). Nonetheless, by performing the Kruskal-Wallis test, the only component found to have a positive and statistically significant correlation with business performance was "Core Technologies" with gross profit margin. All other relationships were found to be tenuous and statistically insignificant.

A limitation of this study stems from the fact that the sample was not adequate. Nevertheless, the results of an exploratory study will be summarized in an improved conceptual model for further research. Also, this survey is made for digital businesses. Future researchers could examine and compare these results with businesses that do not operate in e-commerce. Furthermore, in this study variables regarding financial performance were used instead managerial perceptions. Thus, future researchers could use managerial perceptions and compare their results with this paper. Finally, this study was done in Greece. Future researchers could repeat this survey in other countries in order to compare the results.

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Digital Transformation through Enterprise Systems: A Variance Model Linking the Drivers of Business Value and the Value Created from Enterprise Systems

(Full Paper)

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ABSTRACT

Currently, the potential of Enterprise Systems to transform organizations is emerging as a popular area of investigation. The aim of this study is to a) identify the means of such transformation or business value creation, beyond operational efficiency, that Enterprise Systems can enable and b) understand the drivers of such ES-enabled business value creation. This paper presented and found empirical support for a new model to establish relationships between the drivers of Enterprise Systems-enabled business value, and the business value created. The proposed model was empirically tested using data analysis of user cases of Enterprise Systems around the world. The study found evidence of support for both association and causality between drivers of business value (integrate, optimise and informate) and the business value created (Mergers and Acquisitions, Innovation, and Strategic Decision Making) from Enterprise Systems. This study can be treated as a foundation for further research for generalization of the proposed causal relationships between the value created by Enterprise Systems and the drivers of such value using detailed case studies, and uncovering more such causal relationships. The contribution of this paper is that it presents and empirically tests a new variance model that establishes causal relationships between drivers of business value from Enterprise Systems (integrate, optimise and informate) and the business value created (Mergers and Acquisitions, Innovation, and Strategic Decision Making).

Keywords: Enterprise Systems, Business Value, Innovation, Mergers and Acquisitions, Strategic Decision Making.

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INTRODUCTION

Information Technology has become an integral and indispensable part of the world of business and commerce. In the past few decades, a variant of such technology, called 'Enterprise Systems', has become widely popular with large organizations, and increasingly so with small to medium-scale businesses. Enterprise Systems (ES) can be defined as large-scale, packaged, application software systems that can be used to streamline and integrate the business processes of an organization, and considerably improve information and knowledge levels within the organization as well as with its customers and suppliers (Davenport 2000). In modern times, ES has become a generic term that includes a number of systems like Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), Supplier Relationship Management (SRM), Supply Chain Management (SCM) and so on.

This brings us to the fundamental questions of business organizations - 'Is this all worth it?' or 'What is the value added?' Business organizations undertake all investments with one overarching goal in mind - business value. Value means the worth or desirability of an entity or object. The term is subjective, and depends on the context. Business Value' or the value from a business organization's perspective means maximizing shareholder returns, increasing market share, gaining goodwill in the market, expansion and growth etc. Such value can be achieved through different ways: improving efficiency of operations and cost savings thereof, innovative service, strategic positioning, improved decision making and so on (Smith and McKeen 2003). All organizations who have already implemented Enterprise Systems or are planning to do so hope to maximize their return on such enormous investments. In other words, they seek to get more out of these systems than just improving operational efficiency; they want to be able to compete better (Holland and Light 2001; Teo et. al. 2006; Ruivo et.al 2014; Sedera et al 2018; Nwankpa 2019).

Information Technology, in general, has been reported to enable business value creation above and beyond improving operational efficiency (Goldsmith 1991; Earl 1993; Sambamurthy and Zmud 1994; Barrett and Walsham 1995; Parker 1996; Weill and Broadbent 1998; Sawy et.al. 1999; Rai et al 2006; Weill and Ross 2009). Furthermore, IT has been widely argued to have a strategic potential – the ability to support organizations to compete better in the market. The Resource-Based View (RBV) of the firm, one of the most useful and powerful theories for studying organizations (Kraaijenbrink et al. 2010), has been used to understand the potential of IT to create competitive advantage by several researchers, e.g., Mata et. al (1995), Wade and Hulland (2004), Piccoli and Ives (2005), Nevo and Wade (2010). They all argue that IT has 'strategic' potential when it is combined with other organizational resources to develop 'IT-enabled' resources. Recently, Sedera et al. (2016) did a study involving 189 organizations and concluded that ES platform has a significant and positive impact on innovation.

With Enterprise Systems as the preferred IT platform, exploiting such systems to compete better in the market has become a trend in the corporate world. Large, multi-national, 'IT consulting' organizations are now claiming to implement and harness

these systems to enable value, beyond operational efficiency, for their clients. Further, all the vendors of Enterprise Systems claim to enhance and equip their software to play a 'strategic' role to enable the adopting organizations to compete stronger in the market (Seddon 2005; Ruivo et al 2014; Rouhani & Mehri 2018; See, Yap & Ahmad 2019).

But despite these claims by vendors and consultants, there is very limited empirical research that explores the drivers of business value creation beyond improving operations using Enterprise Systems. So there exists an opportunity to look at the strategic potential of Enterprise Systems - the contribution of such systems in enabling business value in addition to improving operations of the adopting organizations.

In particular, there is a gap in research so far on the causal links between the individual drivers of ES-enabled business value and the different means of business value created by Enterprise Systems. The novelty of this paper is that it seeks to explore the unexplored area of the causal relationships between drivers of business value and the types of business value created by Enterprise Systems. This leads to the research question:

How is business value creation, beyond operational efficiency, driven from Enterprise Systems?

DRIVING ENTERPRISE SYSTEMS-ENABLED BUSINESS VALUE BEYOND OPERATIONAL EFFICIENCY: A REVIEW OF THE LITERATURE

Firstly, it should be noted here that for this research, we are interested in the ES-enabled business value creation beyond operational efficiency in the long run. It has been found by many studies that organizations have adopted Enterprise Systems and benefitted significantly from the operational efficiency they provide in the form of less errors, faster data entry, better monitoring of operations and others (Sumner 1999; Shang and Seddon 2002; Spathis and Constantinides 2003; Davenport 2004; Motiwalla and Thompson 2009; Seddon et al. 2010; Rouhani & Mehri 2018). But the motivation for the study is to go beyond the operational benefits of Enterprise Systems and explore how these systems can enable business value beyond operational efficiency.

A systematic review of the literature on Enterprise Systems revealed three commonly mentioned means (in addition to improving operations) by which Enterprise Systems can enable business value through:

- a) Mergers and Acquisitions, as suggested by Gupta (2000), Grainger (2007), Mehta and Hirschheim (2007), and Weill and Ross (2009), Hedman and Sarker (2015), and Henningson et al. (2018).
- b) Innovation, as suggested by Rajagopal (2002), Bradford (2003), Swanson and Pang (2005) and King (2006) and Srivardhana (2007), Romero and Vernadat (2016), Lasisi et al (2017), Boscoianu et al. (2018).
- c) Strategic decision-making, as suggested by Bligh and Turk (2004), Spathis and Constantinides (2004), Rom and Rohde (2006), Goodhue et. al (2002), Rigby and Ledingham (2004), Teittinen et. al (2013), Romero and Vernadat (2016), Heidary et al. (2018), Holsapple, Sena and Wagner (2019)

The systematic literature review conducted by the author to arrive at the above-mentioned 3 means is explained as follows. Given that Enterprise Systems were initially developed to provide operational efficiency, and are only recently being looked at for other ways of creating business value, there isn't much prior research in this area. Therefore, a detailed systematic review of literature was done to identify means (in addition to operational efficiency) in which IT, in general, can enable business value. Such a review (as summarized in the Table 1) supported two common means through which IT enables business value: a) innovation- new products/services and new processes and b) strategic decision making.

Table 1: A systematic review of studies showing the key means of business value created by IT

Study	Means of Creating Business value with IT	IT Supports Innovation?	IT Supports Strategic Decision Making ?
Sambamurthy and Zmud (1994)	-New Products and Services -Transformed Processes -Enriched Organizational Intelligence	Yes, in -New Products and Services -Transformed Processes	Yes, in -Enriched Organizational Intelligence
Mooney et al. (1996)	-Automational -Informational -Transformational	Yes, in -Transformational	Yes, in -Informational
Weill and Broadbent (1998)	-Infrastructural -Transactional -Informational -Strategic	Yes, in -Strategic	Yes, in -Informational
Tallon et al. (2000)	-Customer relations -Supplier relations -Sales and Marketing -Productions/operations -Product/service enhancements -Process planning and support	Yes, in -Product/service enhancements -Productions/operations	Yes, in -Process planning and support
Applegate et al.(2003)	-Assist auxiliary support -Support core processes -Support strategy of the firm -Innovate	Yes, in -Innovate	Yes, in -Support strategy of the firm
Sambamurthy et al. (2003)	-Agility -Digital options -Entrepreneurial alertness	Yes, in -Agility -Digital options	Yes, in -Entrepreneurial alertness
Kohli and Grover (2008)	-Co-creating with partner organizations -Embedding IT into processes -Reassessing and making decisions by information analysis	Yes, in -Embedding IT into processes	Yes, in -Reassessing and making decisions by information analysis
Weill and Ross (2009)	-Operational performance improvements -Acceleration product/service innovation -Reorganization around customer-oriented processes -Integration of Mergers and Acquisitions	Yes, in -Acceleration product/service innovation	Yes, in -Reorganization around customer-oriented processes

Source: This Study

It may be noted that support for Mergers and Acquisitions as a means of creating value with IT was found in the study by Weill and Ross (2009) only. However, enabling Mergers and Acquisitions seems especially important in the case of Enterprise Systems, as a specialized variant of IT, as suggested by Gupta (2000), Grainger (2007), Mehta and Hirschheim (2007), Weill and Ross (2009), Motiwalla and Thomson (2009) and Henningsson et al. (2018). So this means was added as a key means of creating business value with Enterprise Systems.

Next, authors like Rajagopal (2002), Bradford (2003), Swanson and Pang (2005) and King (2006) have suggested the concept of innovating with Enterprise Systems. However, they study the implementation of such systems as an innovation by itself; they have not said much to address the new opportunities these systems can create through new products and processes. Shang and Seddon (2002) in their classification of the benefits derived from Enterprise Systems have mentioned building business innovations and generating product differentiation as benefits in the 'Strategic' category. However, this has not been discussed to much depth. Srivardhana (2007) studied how Enterprise Systems can enable innovation and found that these systems can both enable and hinder process innovation - a rather interesting finding. So there is an opportunity to explore this phenomenon further (Boscoianu et al., 2018).

Finally, researchers have also begun to explore the role of Enterprise Systems in strategic decision making. Davenport (2000) suggests that the key strategic areas in which Enterprise Systems can play an important role are the sense-and-respond business

models, globalization and in extending the value chain. Goodhue et al. (2002), Bligh and Turk (2004), and Rigby and Ledingham (2004) suggest that CRM systems have strong strategic potential for increasing market share by using them to manage customers through better promotion of products/services, better customer service and better identification of profitable customers. A survey revealed that ERP systems enable profitability analysis by business segments; this analysis assists in strategic decision making by top management members (Spathis and Constantinides 2004). The Data Warehouse and Business Intelligence technologies translate the business strategy into Key Performance Indicators and analyze them to reveal how the organization is performing (Bose 2006; Heidary et al. 2018; Holsapple, Sena and Wagner 2019).

Having reviewed the means of creating business value beyond operational efficiency, it is now useful to look at the drivers that drive such business value from Enterprise Systems. A review of the literature shows that there is little research that deals with the drivers through which Enterprise Systems can enable mergers and acquisitions, innovation, and strategic decision making—the key interest for this research. The best known studies are the ones that discuss the drivers of Enterprise Systems-enabled benefits in general. Kennerley and Neely (2001) said that better information availability and better designed business processes are the ingredients to realizing organizational benefits from Enterprise Systems. Davenport et al. (2004) have suggested that organizations achieve business benefits from Enterprise Systems by integrating data and systems, optimizing business processes and accessing and analyzing real-time information. Gattiker and Goodhue (2005) propose the drivers of benefits as data quality, task efficiency, and coordination improvements. Davenport et al.'s (2004) long-term benefit drivers (integration, process improvement, and informing) map very well to Gattiker and Goodhue's model: the 'interdependence–coordination–improvement' link indicates integration, 'task efficiency' implies process optimization, and 'data quality' implies benefits from improved access to information. Seddon et al. (2010), in their 'OBES' model, reinforced the three factors that Davenport proposed – integration, process optimization and informing. Therefore, the key drivers of Enterprise Systems-enabled business value identified from the literature are (a) integrating, (b) optimising and (c) informing.

Furthermore, a few attempts have been made to find causal relationships between (a) drivers of value and (b) the business value created by Enterprise Systems. Davenport et al.'s (2004) study demonstrates association using correlation figures which are moderately positive in all cases. For example, a correlation coefficient of 0.19 between the constructs 'Integrate' and 'Benefits Realized' indicates an association between these two constructs. In other words, within the sample studied, on average, the more the organizations integrated using Enterprise Systems, the more benefits they realized. As an extension / reconfirmation of the study on the drivers of business benefits from ES by Davenport et al. (2004) discussed in detail earlier. Seddon et al. (2010) proposed a long-term, multi-project model listing factors that drive organizational benefits from Enterprise Systems. The model suggests that in the short-term, two factors, namely 'functional fit' and 'overcoming organizational inertia', drive organizational benefits from the different ES projects. Also, the model suggests that in the long-term, four factors, namely 'integration', 'process optimization', 'improved access to information', and 'on-going ES business improvement projects', drive benefits from Enterprise Systems. This study is a synthesis of project-based studies around Enterprise Systems and the long-term benefits derived from such systems. However, this study also does not delve into much detail about the different types of benefits that these organizations realize.

It is evident that neither Davenport nor Seddon attempt to link the drivers of benefits to any particular types of benefits or business value. So, these studies refer to benefits or business value in general and have not proposed any drivers of value to enable business value through specific means. In other words, the drivers of Enterprise Systems-enabled benefits identified are for benefits in general, not for any particular kind of benefit. Therefore, there exists a gap in literature which is intended to be addressed by this paper. The pages below attempt to do this by formulating, discussing and justifying four hypotheses (marked by arrows in the Figure 1), based on logic and evidence from past studies. These hypotheses are also tested empirically later in this paper.

TOWARDS A NEW MODEL: LINKING DRIVERS OF ES-ENABLED BUSINESS VALUE TO THE BUSINESS VALUE CREATED

As established in the previous section, Enterprise Systems have the potential to deliver business value above and beyond operational efficiency, mainly through the means of enabling (a) mergers and acquisitions, (b) innovation and (c) strategic decision making. It was also established that the key drivers of Enterprise Systems-enabled business value identified are (a) integrating, (b) optimising and (c) informing. The two tables below define and explain each of these concepts.

Table 2. Drivers of Business value with Enterprise Systems (based on Davenport et al. 2004)

Construct	Meaning
Integrate	'harmonize the data, processes and systems within the organization as well as beyond the boundaries, extending to customers, suppliers and other stakeholders'
Optimize	'standardize the processes (both front-end/customer facing and back end/administrative) by aligning them with best practices or modify/enhance processes to meet the strategic needs of the organizations that yield competitive advantage'
Informate	'provide access to real time data and the capability to analyze the internal organizational performance and the behaviour of external stakeholders like customers and suppliers'

Source: This Study

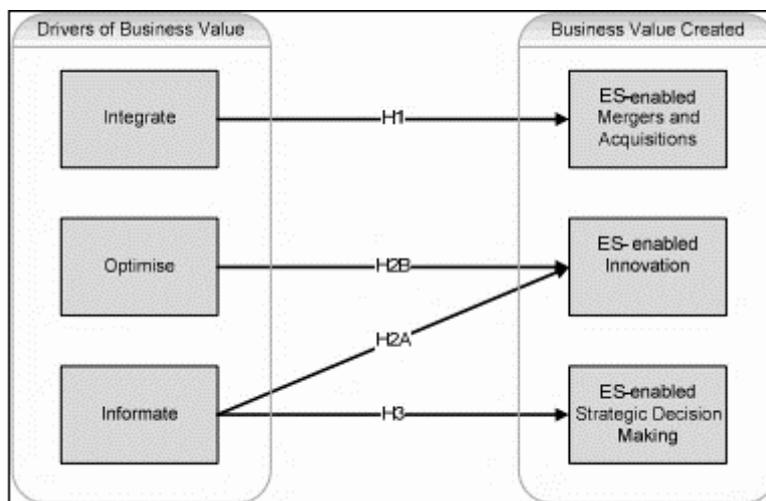
Table 3. Business Value Created using Enterprise Systems (based on Weill and Ross 2009)

Construct	Meaning
Mergers and Acquisitions	Mergers and acquisitions (M&A) occur when two or more organizations join all or part of their operations. The businesses of both organizations are brought together as one (Doyle 2000). They help a business entity grow rapidly in either a) its sector or location of origin, or b) a new field or new location, thus achieving inorganic growth.
Innovation	Innovation adds unique value for the customers, enables competitive advantage and generates value for shareholders (Drucker 1985, Snyder and Duarte 2003). The dimensions along which an organization can undertake innovation are product and process (King et al. 1994; Christensen 1995; O'Sullivan and Dooley 2009). Product Innovation: Product innovation can be said to be the development of new products, changes in design of established products, over time (Dougherty and Hardy 1996) Process Innovation: Process innovation is 'the critical analysis and radical redesign of work flows and business processes to achieve dramatic improvements in important measures of performance' (Martinsons 1995 p.254)
Strategic Decision Making	Strategic decision making involves making 'intentional choices or programmed responses about issues that materially affect the survival prospects, well-being and nature of the organization' (Schoemaker 1993 p.107).

Source: This Study

The motivation of this paper is to establish relationships between the drivers of Enterprise Systems-enabled business value, (i.e., Integrate, Optimize, Informate) and the business value created (Mergers and Acquisitions, Innovation and Strategic Decision Making). As established earlier and to the best of the author's knowledge, there is a gap in research so far on the causal links between the individual drivers of ES-enabled business value (i.e., Integrate, Optimize, Informate) and the different means of business value created. So a new Variance Model is proposed to address this gap.

Variance models are based on the assumption that variation in predictors or independent variables is responsible for variation in outcomes or dependent variables. (Mohr 1982; Van de Ven and Huber 1990; Newman and Robey 1992, Wynn and Williams 2012). The proposed Variance Model takes a step further by attempting to link these three drivers to the particular means of business value creation: an aspect missing in the work of both Davenport and Seddon.



Source: This Study

Figure 1: A Variance Model to show the relationship of the drivers of business value and the business value created

The purpose of this section is to present and discuss this new Variance Model shown in Figure 1. The constructs (denoted by the boxes) of the model are defined in the Tables 2 and 3 and the hypotheses (denoted by the arrows) embedded in the model are explained in the following sections.

‘Integrate’ Facilitates ‘Mergers and Acquisitions’

Firstly, as stated in Hypothesis H1 in the Figure 1, it is argued that Mergers and Acquisitions are facilitated by employing the ES to ‘integrate’. IT-based systems are a key component in the integration phase of the merger and acquisition process (Galpin and Herndon 2007; Mehta and Hirschheim 2007). A major problem in post-acquisition integration of mergers and acquisition is to combine a plethora of isolated systems of the two (or more) organizations. This means that the greater the number of systems in each merging organization, the more difficulty the merged entity would experience in merging systems. It has been found that integration of disparate systems in an organization is a cumbersome task and the ES should be employed to integrate several systems into one integrated platform. Therefore, having an ES in place usually means that the organization has an integrated system platform already in place.

Enterprise Systems by definition are integrated systems, i.e. different systems components like finance, HR, operations are logically integrated into a single system. When an organization undertakes a Mergers and Acquisitions initiative, having integrated systems such as ERP Systems in place helps to smoothen out the process of integrating the systems of the two (or more) organizations, which is one of the most complex, time-consuming, error-prone, and expensive tasks involved in Mergers and Acquisitions. With Enterprise Systems in place, the acquiring organization needs to integrate one or more systems of the acquired organization(s) into the one single system of its own during the ‘post-acquisition integration’ phase of a merger of two or more organizations. ERP systems adopted by manufacturer firms have been reported to assist in quickly integrating systems following mergers and acquisitions in prior studies (Gupta 2000; Grainger 2007; Bourgeois III et al. 2017; Henningson et al 2018). For example, Danisco, a global food ingredients organization built its ‘growth-by-acquisition’ strategy based on its SAP ERP and CRM platform, which it used to integrate its acquiring organizations into (Yetton et al. 2013). Furthermore, if the acquired organizations have integrated Enterprise Systems themselves, this may further assist the M&A initiative, given the even lower number of systems to integrate (Henningson et al. (2018).

The above section suggests that a high degree or extent of integration of systems, data and processes within the organizations prior to takeover supports their IT-systems-merger initiatives (if these are thought desirable). This insight can be summarized as:

Hypothesis 1: The more the acquiring organizations employ their Enterprise Systems to integrate processes and data, the easier it is for them to undertake mergers and acquisitions

‘Informate’ Facilitates ‘Innovation’

Secondly, it is argued that Innovation is facilitated by employing the ES to a) ‘informate’ as well as b) ‘optimise’. As stated in Hypothesis H2A, ‘Informating’ enables insight to information about customer needs, thus being able to identify gaps between what customers want and what products/services are offered. This information forms the basis of the ‘idea generation’ activity of undertaking innovation, as suggested by Tushman (1977). An example is the use of customer interaction information from CRM systems to understand the needs of customers from the nature of their requests and complaints. This will assist the organization to launch a new product or a service that customers appreciate. For example, in a CRM context, identifying what, when, where in terms of past customer interactions could reveal more insight into exact customer needs (Bligh and Turk 2004). This can be done by analyzing the integrated information in the ES using the analysis tools (like OLAP and data mining) provided by the ES. In turn, this could trigger new product innovation. (Romero and Vernadat 2016). Often, new services are delivered through the ES, or using the ES as a back-end. For example, it is possible to offer a new service by integrating the organization with its supply-chain partners. UPS, the parcel delivery giant, implemented Oracle Enterprise Systems to provide a range of services to customers including tracking deliveries as a means of product/service differentiation (Motiwalla and Thomson 2009; Boscoianu et al. 2018). Therefore, it can be said that informing leads to innovation, leading to the hypothesis: *Hypothesis 2A: The more the adopting organizations employ their Enterprise Systems to informate, the easier it is for them to undertake innovation*

‘Optimise’ Facilitates ‘Innovation’

Again, as stated in Hypothesis H2B, it is argued that optimized processes facilitate implementing the innovation, thus facilitating the ‘implementation’ activity of innovation, as suggested by Tushman (1977). Often a new product or service is delivered electronically, and very often the ES is used to implement the service. For example, a new online parcel tracking service is offered to customers using a web-based Enterprise System. Particularly, process innovation can be accomplished by creating new processes or wholly redesigning existing processes, enabled by Enterprise Systems (Swanson and Pang 2005). ERP systems, with their built-in process modelling tools and implementation of processes, can be used for Business Process re-engineering: the foundations of process innovation. In Geneva Pharmaceuticals, business processes were categorized into supply and demand groups, and processes in each of the two groups were re-engineered and then integrated (Bhattacharjee, 1999). Again, in Textiles PLC, business processes were revamped to fit the strategy of one global organization using the Enterprise System (Holland & Light, 1999). Wipro Consulting adopted ERP to implement human resource self-service: a new model for managing their strategic resources, i.e., employees (Motiwalla and Thomson 2009). This can be in back-end

processes by using the ‘best practices’ of the Reference Models in ERP Systems or the customer-facing processes by adopting the marketing-sales-service cycle of CRM systems. Enterprise Systems assist in completely redesigning business processes or inventing new processes using their ‘optimised’ built-in best practices. These best practices are developed over the years from processes of high performance organizations in different industries (Lasisi et al 2017). So it can be argued that aligning most of the business processes of the organization to ‘best practices’ of Enterprise Systems leads to many new innovative processes being introduced into the organization. The insight above can be summarized as:

Hypothesis 2B: The more the adopting organizations employ their Enterprise Systems to optimise processes, the easier it is for them to undertake innovation

‘Informate’ Facilitates Strategic Decision Making

Thirdly, as stated in Hypothesis H3 it is argued that Strategic Decision Making is facilitated by employing the ES to ‘informate’. Exploitation of IT/IS capabilities in general to play a role in formulating business strategies was found to be useful by several researchers (Applegate et al. 1996; Goldsmith 1991; Robson 1997). Kearns and Lederer (2000) summarize such studies and propose a useful model of interaction of Information Systems Planning (ISP) and Business Strategy/Planning (BP) wherein both are shown to positively impact each other. Enterprise Systems, in particular, when used to informate using the high-quality information available and the specialized analytics capability provided with the business intelligence technologies, assist in profitability analysis (Spathis and Constantinides 2004, Lasisi et al. 2017). Davenport (2004, 2006) suggests that the analytics capabilities of the built-in business intelligence tools in Enterprise Systems can be used to make strategic decisions like identifying the most profitable customers and retaining them, determining the optimum price for maximum yield and selecting best employees at optimum compensation levels. This opens up several opportunities to consider, which were not available for analysis at the time of formulating the business strategy prior to having the system. Thus we see that informing using ES helps in both ‘organizational analysis’ (most cost-incurring departments) as well as environmental analysis (most profitable customers), as suggested by Harrison (1996).

Components like SAP’s Strategic Enterprise Management (SEM) suite assist in the actual strategic management process, including creation/recreation of the strategy. To examine and review new business opportunities, tools for executing the activities of strategic management are also built into most ERP systems, like SAP’s Business Planning and Simulation (BPS), Business Consolidation (BCS), and Corporate Performance Monitoring (CPM), which assist in both ‘informating’ to carry out the strategic management process. A study by Rom and Rohde (2006) suggested that a tight collaboration with ERP and Strategic Enterprise Management Systems (which is built-in to ERP Systems now) is very beneficial for a coordination of tactical and strategic decision making. Since it can be said that the availability of quality information in real-time, and the tools to analyze it support strategic decision making (Heidary et al. 2018; Holsapple, Sena and Wagner 2019), it is hypothesized that:

Hypothesis 3: The more the adopting organizations employ their Enterprise Systems to informate, the easier it is for them to make sound strategic decisions

It may be noted that the word ‘more’ in the hypotheses above refers to the extent to which

- (a) data and systems were integrated, as measured by the amount of data or the number of systems integrated (for Hypothesis H1)
- (b) processes were optimised, as measured by the number of processes optimized or the functional areas (for Hypothesis H2B)
- (c) informing was made possible, as measured by the amount of data made accessible and ready to be analysed (for Hypotheses H2A and H3)

Other Potential Relationships: Beyond Scope

There could be other relationships between the drivers and the business value created that can potentially be valid (eg: Integrate leads to Innovation). However, given that no evidence of other such relationships were found in the literature, and the constraints of time for finishing the study, these are not considered here. These relationships can be explored in the future.

TESTING THE VARIANCE MODEL WITH EMPIRICAL DATA

Methodology

Since this study involves the use of Enterprise Systems in organizations, the unit of analysis is organizations. However, a selection criterion was applied to choose the sites. This is as follows:

- Large firms with at least \$500 million plus USD yearly revenue
- Successfully ‘gone-live’ with ERP and/or CRM from any leading vendor
- Post-shakedown phase (i.e. 6-12 months after a major release)

A sample of 94 cases of large firms from across the world that have adopted an Enterprise System from the market leader vendor SAP was found online. Some of these cases were short (two pages or so) and some much longer and detailed (15-16 pages). These cases can be found at: www.sap.com/solutions/business-suite/erp/customers/index.epx and www.sap.com/solutions/businesssuite/crm/customers/index.epx. These cases were endorsed by the client firms and published as business transformation cases of customer organizations enabled by SAP ERP and/or CRM systems (including in-built business intelligence technologies). Analysis of the content of these user cases combines some of the strengths of a survey and a case study. Being reasonably content intensive, vendor-provided success cases provide some insight to each user organization, as is possible with case studies. In addition, the use of a large number of cases provides a means to obtain information across different industries in different parts of the world, as is done in a survey.

For this research, the cases thus obtained were subjected to content analysis. The success cases were downloaded and printed out in hard copies. Each success story was scanned and reviewed, one by one, to find evidence for the four propositions of the proposed framework. Wherever found, such evidence was marked and annotated using a coding scheme used for this purpose. Though not collected first hand by the researcher, these multiple stories provide verifiable data for review and analysis.

Since these user cases are provided by vendors, there can be two potential issues with such data:

- The data may not be considered to be credible
- The data may not truly reflect the opinions of the members of the client organizations
- However, these two issues are addressed in the following ways:
- These success cases are from the most reputed vendor of Enterprise Systems (SAP) and are publicly available; hence they bear little risk of being false
- These success cases contain the contact details of the organizations as well as their top management members with quotes from their interviews for verification

Moreover, use of vendor published success cases has been used widely in prior research on Enterprise Systems like the much cited work by Shang and Seddon (2002). This research methodology has been proved to be very useful in the area of Enterprise Systems research where the data is collected from publicly available documents that contain the insight and experience of the adoption of such systems from the client organizations' perspectives. These cases served as secondary data (Jarvenpaa 1991) for testing the proposed model.

Validity and Reliability

Validity can be defined as how precisely the account represents participants' realities of the social phenomena and is plausible to them. Validity is associated with honesty, authority and defensibility. In the current study, validity of the data is assessed by:

- Comparing the data with the available literature on benefits of Application Systems in general and Enterprise Systems in particular.
- Peer reviewing by involving other researchers to evaluate the data and ascertain whether the researcher has satisfactorily interpreted the data.

Reliability, is dependability or consistency and a living relationship between the researcher and the data. The concept of reliability deals with the issue of whether the process in which the research is conducted is trustworthy and consistent over a period of time. In the current study, reliability of the data is assessed by:

- Reviewing all empirical evidence iteratively
- Checking the transcribed data for accuracy
- Using data from organizations all across the world
- Reviewing all empirical evidence by peers and colleagues to assess the analysis and interpretation

Findings

Evidence to support the model is provided in two parts: Evidence of Causality and Evidence of Association.

Evidence of causality

The following section contains illustration of evidence found from the data from user cases to support the Variance Model and its hypotheses.

Hypothesis 1: The more the acquiring organizations employ their Enterprise Systems to integrate processes and data, the easier it is for them to undertake mergers and acquisitions

Canadian National Railway Company (CNRC) is one of the earliest freight railroads around the globe and a leader in the North American rail industry, based in Montreal, Canada. The company now spans across Canada, mid- America and Mexico. CNRC made a strategic decision to adopt ERP to address the following key themes: assist its growth strategy through mergers and acquisitions of 4 other railways, improve information levels and analytics capability for operational efficiency and assist in innovation and agility. The organization got SAP ERP and Product Lifecycle Management (PLM) suites implemented from 1999 to 2005. CNRC used the system for integrating systems and sharing information with its 22, 250 employees widely dispersed across North America.

“CN has integrated and consolidated the functionality and data from over 100 computer applications into one seamless SAP platform”. (F. Grisby, Senior Vice-President and CIO)

SAP ERP clearly assisted in consolidating the IT systems that resulted from the growth strategy of CNRC- Mergers and acquisitions. The CN Mergers with Illinois Central in 2001, Wisconsin Central in 2003, Great Lakes Transportation in 2005 and British Columbia Rail in 2005 were supported by the ES platform. CNRC's profits rose 34% to CAD 2 billion in 2006. Thus, integrating using Enterprise Systems was a causal enabler of mergers and acquisitions.

Hypothesis 2A: The more the adopting organizations employ their Enterprise Systems to informate, the easier it is for them to undertake innovation

Hypothesis 2B: The more the adopting organizations employ their Enterprise Systems to optimise processes, the easier it is for them to undertake innovation

Energen Corporation is a diversified energy holding company headquartered in Birmingham, Alabama with annual revenue of USD 1394 million. It has two lines of business: development of domestic, onshore natural gas, oil, and natural gas liquids reserves; and natural gas distribution in central and north Alabama. It implemented SAP ERP and Human Capital Management solution. The system was used to achieve streamlined payroll processing and achieve process innovation by completely automating W-2 processing. In addition, Energen can now run payroll simulations. Energen conducted a detailed engagement to map out all the organizational business processes to optimise them.

“With SAP software, we have been able to increase our payroll processing efficiency. Reconciliations are significantly smoother. Also, the system uptime has improved as access is available during payroll runs.” (Willie Shepherd, Manager of Payroll)

In addition, with enhanced reporting capabilities, Energen can now automate and integrate safety reporting (OSHA 300) and drug testing.

“Without it [SAP software], changing any business process would have been extremely difficult.” (Brunson White, Vice President and CIO)

Thus, optimising using Enterprise systems was a causal enabler of Innovation.

Hypothesis 3: The more the adopting organizations employ their Enterprise Systems to informate, the easier it is for them to make sound strategic decisions

Pick n Pay Group is a market-leading retailer in South Africa and operates hypermarkets, franchise stores, supermarkets, convenience stores, and clothing stores with annual revenue of 3.5 billion Euros. The firm adopted SAP for Retail, the SAP ERP and the SAP Net Weaver Business Warehouse. The SAP Business Suites enabled quicker access to a deeper level of detail in general ledger, simpler and real-time ledger analysis, and query resolution. Financial personnel can access in-depth general ledgers, drill down for better query resolution and analysis, and also analyze the regional ledgers online in real time. Simultaneously, stores can instantly view details of their actual expenditure. It also enabled the top level managers to react quickly to changes in the competitive markets. Finally, the retailer has the agility and flexibility to handle dynamic business needs and pursue strategic initiatives, like the opening of a chain of convenience stores.

“With SAP software as the foundation of our business system environment, we can pursue the business opportunities that distinguish us from the competition and allow us to be more responsive to customers.” (Bronwen Rohland, Director of Strategy, Information Systems, and Supply Chain & Sustainability)

Thus, informing using Enterprise systems was a causal enabler of making sound strategic decisions.

Evidence of association

A survey-like study using all the 94 cases in the aforementioned sample was done to assess the extent of statistical association between the dependent and independent variables of the hypotheses. A 4-point scale (0-3) was designed to measure the strength of evidence of the variables of the model in the sample where 0 meant no evidence of the constructs and 3 meant very strong evidence clearly mentioned as excerpts from interviews/text or clearly implied.

The cases were analyzed, one at a time, by the first author to assess the strength of evidence of each variable (e.g., Integrate and Mergers and Acquisition). Quotations from managers of the client firms as well as text and numbers in the body of the cases were searched for evidence and marked. For example, in the Canadian Railways case, as illustrated by the quotes provided in the previous section, and other such evidence, a score of 3 was given to the construct ‘Integrate’ for that case. Similarly, for each of the 94 cases, a score from 0 to 3 was assigned to each of the six variables in the model using the rules for scoring. This provided a dataset (as shown in Table 4) as the base for quantitative analysis to test the model.

Table 4: Sample Extract of the Dataset

Case	Integrate	Optimise	Informate	Innovation	Mergers & Acquisitions	Strategic Decision Making
Pick N Pay	3	3	3	3	0	2
Energen	0	3	3	2	0	2
Canadian Railways	3	2	3	0	3	0
Synopsis	3	3	3	0	3	0
Bentoel Group	3	2	3	0	0	0
Coca Cola Bottling	3	0	0	0	0	0
Digitel GSM	2	3	3	0	0	3
Lennox	3	3	0	2	0	2
Francotyp Postalia	2	2	3	3	0	0

Source: This Study

From the dataset obtained as shown by the extract in Table 4, Spearman's Correlation Coefficients (ρ) between the respective independent variables (Integrate, Optimise and Informate) and dependent variables (Alliance innovation, Process innovation, Reshaping Strategy) as per the hypotheses were calculated. As there is no dependent variable shown to be affected by multiple independent variables, there was no need to do a multi-variate analysis of the data. The results of these calculations are shown in Table 5:

Table 5: Evidence of Relationships of the Model

Hypothesis	Independent Variable	Dependent Variable	Spearman's Correlation Coefficient	Significance (p-values)
1	Integrate	Mergers and Acquisitions	0.26	0.01
2A	Informate	Innovation	0.37	0.00
2B	Optimise	Innovation	0.37	0.00
3	Informate	Strategic Decisions	0.29	0.00

Source: This Study

DISCUSSION

Overall, support for the causality for Variance model of the proposed framework was found. Again, for evidence of association, the significant ($p \leq 0.01$) positive correlation coefficients, as shown in Table 4 between the relevant variables of the model, supported the three hypotheses shown in Table 4. In particular, the results supported the following: the more the firms integrate using Enterprise Systems, the easier it is to undertake mergers and acquisitions (H1); the more the firms optimize and informate using Enterprise Systems, the easier it is to undertake innovation (H2); the more the firms informate using Enterprise Systems, the easier it is for them to make sound strategic decisions (H3). These correlation figures provided evidence of association between the constructs of the hypotheses, not of causality. However, the causality of the hypothesized relationships is supported by the extracts as shown in the prior section titled 'Evidence of Causality'.

CONCLUSION

This study, in an attempt to answer the research question, proposed a new model to establish relationships between the drivers of Enterprise Systems-enabled business value, (i.e., Integrate, Optimise, Informate) and the business value created (Mergers and Acquisitions, Innovation and Strategic Decision Making). The causal relationships proposed by the model were tested and reasonably strong evidence was found to support the propositions.

The contribution and novelty of this study is two- fold. Firstly, it proposed that Enterprise Systems can create business value beyond operational benefits, specifically through mergers and acquisitions, innovation and strategic decision making. Secondly, it identified the drivers of such ES-enabled business value, i.e., (a) integration using ES can drive mergers and acquisitions (b) optimization and informing using ES can drive Innovation and (c) Informing using ES can drive strategic decision making. All these hypotheses were tested and supported using empirical data.

This paper has implications for further research but identifying more relationships. For example, the 'integration' of data and processes with suppliers and retailers can lead to the innovation of a new supply chain process. So there is a potential link between 'integrate' and 'process innovation'. Specialized tools like SAP's Business Planning and Simulation (BPS) and Corporate Performance Monitoring (CPM) in ERP packages contain practices to help in 'optimising' the strategic management

process. So it could be possible that 'optimise' assists in 'strategic decisions'. More such relationships can be explored by future research. The limitation of this paper is that the empirical test conducted is limited to secondary user reports. However, this limitation also paves the way for further research. To improve the generalizability of the proposed model, it should be tested further with more empirical data using detailed case studies of a number of organizations.

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APPENDIX A: LIST OF CASES USED IN THE STUDY

Below is the list of the names of all the organizations used for this study.

Air France	Fulton County School	Powell
Air Products	Goldcorp	Powerwell
AMD	GPI	Prati
Aquarion	Grasim Industries	Propex
Arctoc Cat	Graybar	Prudential Asset
Asian Paints	Greenhech Fan	Rion
Aspen	Gruma	Ruchi
Bentoel Group	Htach Holland	San Louis Obispo
Bluewater Power Corporation	HP Latin America	Sentri
Brumbow Mills	Index Living Mall	Slade Gorton
Canadian Railways	Inelectra	Solae Company'
Check	Intelli	Spinmaster
Chep	Jab Josef	State Industrial
Cherry	JSL	Steelscape
Coca Cola Bottling	Lennox	Synopsis
Colgate Palmolive	Linfox	Takaoka
Computer Sciences Corporation	Mattson	Tallard
Conagra	Mediline	Tasty Baking
Coop	MEI	Tersano
Day and Zimmerman	Middle Tennessee Electric	Tessengerlo
Defence Logistics	MonierLifetilr	Thomas Steel
Digitel GSM	Monsanto	Thomasville Furniture
Directv	New York Power	Thrifty Foods
Eastman	Newport	Tomoegawa
Efi	Nippo	Trincherro Family Estates
Electra	Nova	United Illuminating
Embry Group	OKI Data	Universidad Techmilanio
Energen	Pacific Coast Supplies	US Dept of Defence
Fields	Paradeep Phosphates	Vertelus
Francotyp Postalia	PickN Pay	Wawa
Fujimoro Kogyo	Port of San Diego	

Source: This Study

Discussion on the Live Broadcast of Social Media and E-Commerce

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ABSTRACT

In recent years, online e-commerce in Taiwan has been widely used by brand owners (advertisers). Live e-commerce has been widely used to be brands communication to consumers due to the popularization of a large number of social media platforms. Communication contents between brands and consumers has a significant increased their sales, and social media communication changed beyond just texts but though the experiences and trusts presented by live broadcasters.

E-commerce has become one of the most popular and dependent channels for purchasing. However, when a large number of products are exposed on the Internet, online marketing is an important key to the overall marketing strategy of enterprises. The use of online marketing to promote brand, message delivery, market research, customer relations, customer service, sales channels and promotional programs have become important means of Internet marketing. In recent years, the continuous growth of e-commerce has also changed the trading behavior of consumers and brands. The Internet has driven real-time transactions. This kind of trading behavior without time and place restrictions will continue to build on good brand values and customer relationship.

This study explores the actual operation of social media by brand owners (advertisers) and the field operators of e-commerce. Due to the proliferation of media marketing, excessive online advertising, bloggers unboxing videos, testimonies, Google simulcasts, keywords, etc., advertising methods including artists and celebrities endorsements have made consumers ubiquitously passive and actively see these advertisements exposed. Thus consumers have begun to gradually lose the intensity of their trust in the media. The use of social media to make brands trustworthy, and consistently maintain a high degree of attachment have always been an important tool and format in the marketing process.

The e-commerce live broadcast uses social media platform to give e-commerce a sense of experience and trust. Using real experience and dictation, the characteristics and key advantages of the product and its own experience directly and indirectly give consumers an expected sense of identity. E-commerce transactions have increased the use of social media to generate trading behavior.

This study first describes the influence of social media (Facebook) on brand owners and consumers, and then defines the actual effects of social media usage tools, especially the live broadcast (store direct broadcast) introducing the goods sold to consumers. The resulting differentiated trust explores the credibility of e-commerce using live broadcasts on social media, and also explores customer relationships simultaneously, directly and indirectly affecting the trust and difficulty of consumers' final purchase behavior, while researching cases show that the brand and social media generated by the live economy are innovative in the ultimate sales trust.

Keywords: Social media, social commerce, media trust, Live E-commerce

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INSTRUCTIONS

Due to the booming development of mobile Internet, e-commerce, the Internet of Things, and cloud computing, the number of tools for the proliferation of advertising media has increased. These have led to the use and output of social media and social commerce. The use of tools and consumer trust and customer engagement to goods. Similarly, because of the rapid delivery of images or pictures through mobile Internet, and the identification of the transmitted images once a video or photo is posted on a social media, a large number of people would often determine what the direction of an event based on their own judgment. As the BBC's business review editor Weber said in 2010, in today's society, a devastating video will be forwarded, clicked by hundreds of people, and it would, like a snowball, roll over and kill a product or a company, and easily destroy the company's stock price. It can be seen that the resistance or assistance that current social media has on brands is both equally strong. The communication through only images and texts is no longer preferred by viewers. They want more participation, interaction, communication, recommendation and other interactive methods these have formed a social aggregation of the Internet. The social media platform has become a tool that brand owners and consumers rely on. And because the mobile Internet has been widely accepted and recognized by the public, live streaming has become another option for brand owners and viewers. The live streamer host is a new profession born in recent years. The new professional role itself requires a low level of professional knowledge. That is, anyone

who has an FB account or an app and website platform with live broadcast functions can do so, they can begin to operate their own live broadcast market. However, what kind of mentality do Taiwanese netizens face with the content of live broadcast? When choosing a live broadcaster to promote their own products, how do brands choose to operate a live broadcast platform and what problems would they face in the process? Would the popularity of the live streamer host generate uncertain traffic due to his/her popularity, and what factors would help generate high-interaction, high-purchasing power netizens, etc.

Research Motivation

We chose FaceBook, which is currently the most commonly used social media by brand owners and consumers in Taiwan, as the basis for setting up a live broadcast platform, exploring brand positioning, and looking for a classification of Taiwanese consumers who are interested in the main live broadcast products. At the same time, when the store merchants on the e-store platform uses "live broadcast" as a marketing diffusion tool in advertising marketing, what is the special "webcast and traffic accumulation" context we can identify, in order to propose a relatively feasible live broadcast positioning design and marketing promotion mechanism. There are three main purposes for this study:

1. Contextual insights between broadcaster viewers and hosts

Aiming at the Taiwan market, the categories of live broadcasters and live broadcast e-commerce platforms netizens are concerned, and what brands care for media diffusion capabilities of live broadcasts, and studying from the contours of different ethnic groups, images of woman, celebrities, and influencers etc., we observed that netizens have greatly changed their live streaming viewing options. A reference from InsightXplorer, a market research company, from a total of 627 valid samples collected from April 27th to May 2nd, 2017. The types of programs people watch are leisure life, including cooking, Food and chatting (46.6%), followed by 38.3% for variety entertainment, and the remaining 34.4% for music or performance playback. (Source: InsightXplorer Interview "What do Taiwanese live streaming netizens watch? ") From the above information, it can be seen that when watching live broadcasts, men still prefer news, sports, and games, while women prefer casual lifestyles such as cooking, food, gossip, skin-care, chatting, and horoscope, these are their higher preferences. Of course, there is also a very prosperous way of selling which is the live broadcast auction. In recent years, live broadcast auction market has won over beautiful webcast hosts. Instead, a host that is knowledgeable of the goods to be sold, has been referred to as "the know-it-all" about the product. He/she is not necessarily a handsome guy or a beautiful woman, but must be a master with in-depth understanding of the product. Introducing the products either with deep knowledge or through stories, it builds a strong connection between consumers and the product sold on live broadcasts.

2. Exploring the demand for live broadcast services on social media

In the past, people share products through their own daily life experiences on social media, there were less real-time broadcasts for viewers to watch or agree on certain products. In the past, even Youtubers are "followed" in order to watch their videos. However, while behaviors are changed from "following" to "real-time interaction," and the cluster effect that was originally on social media, the e-store business platforms should think about how to build stronger connection and trust between the live stream host and the product. More importantly is how to start from the context of consumers' purchase behavior on social media. Thinking about the design of live broadcast contents of the store and the role of the "live broadcast host" would be another issue that need attention.

3. The design and brand advertising of the e-commerce company itself and its marketing channel.

In the past, advertising methods such as promotion, free shipping, and diversified products were generally used as the main communication mode to consumers on online e-commerce platforms. However, in the digital age, more and more users use active push and pull methods to place products on the e-commerce platform to the mobile phones or computers that consumers are watching, but they neglected the fact that contemporary communication model of people has changed. More consumers care about communicating the experiences in real time. Live broadcast host introducing directly the products and writes the unboxing text have already become a marketing method that e-commerce platforms must operate. The brand awareness of the e-stores themselves is also an important issue that should never be ignored. In addition for e-store platforms to introducing brands through products, would there be any other possibilities for innovative marketing design and experience? This is another topic to be explored in this research.

In summary, this study intends to study the innovativeness of brands, and the trust generated on social media by the live broadcast economy in the final sales of the product from the user's perspective. Investigating the consumer's business behavior context on live broadcasts, and propose innovative business models for products and services. The following describes the literature review, and preliminary research findings.

LITERATURE REVIEW

The range of online media can be very large, and the tools used are very wide. Since the current network technology can track how loyal consumers browse various products on the Internet, in this way, manufacturers will also be clear and understand the needs of

consumption, understand the demand, in order to accurately deliver the advertising marketing that consumers need. At the same time, because the Internet can be used to set up personalized marketing, by consuming the factors that have common characteristics or needs, it will gather the same interest, or a group of consumers of the same type, through their interaction on the Internet and quickly feedback to the operators, allowing a very accurate push of digital marketing. Such a precise delivery method, allows consumers to have a long-term information exchange relationship with the manufacturer and the environment.

In addition to accurate placement or repetitive placement on viewers' web pages, another important aspect is interaction, the realistic feeling consumers need, and the direct dialogue. The sense of reality is an important part of online marketing, so that consumers have a high degree of engagement, no longer "over packing," but realistic experience and sharing.

Therefore, the effects of commodities on consumers' digital marketing are the subject of research. This chapter will focus on media rich theoretical perspectives, AIDA models, AISAS model theory, experience marketing, consumer satisfaction and loyalty, and consumer purchasing decisions. Relevant theory review of advertising effectiveness, online advertising metrics, Ogilvy & Mather 360 degree brand stewardship, related literature discussion, as the basis for the establishment of follow-up research structure.

1. Media Richness Theory

It refers to the ability of communication and contact. The media has an important role in transmitting information. Different media will have different communication skills. The rich media can get different height or low according to the number of feedback, language diversity, multiple clues and personal attention (Daft, R.L. & Lengel, R.H. (1984). If such information is fast in understanding, we regard it as rich, and its contrary would be a less rich media. Media richness theory believes that the purpose of organizing information processing is to reduce uncertainty and equivocality. These two directions can be used to explain the media nature of different information technologies. Since the Internet itself exists in a virtual space, and the tourism goods themselves are a purchase item that cannot be seen, it is necessary to collect and compare information through more online media, commodity information, EDM, youtube video, online news, etc., which are loyal to consumers, provide consumers with different levels of richness. Many studies have found that digital marketing of a large amount of multimedia content, using a large number of customer interactions, text, pictures, animation, images, virtual reality, actual use of experience and other information, so that the media richness increases, but also allows consumers to have more judgment and recognition ability to improve the credibility of digital marketing information.

2. Experiential Marketing

Experiential marketing is now a marketing tactic that consumers think is necessary. The best representative is Bernd Schmitt (1999), who mentioned in his book (Experiential Marketing) that the concept of experiencing marketing is after observing or participating in an event, individual customers feel certain stimuli and have engines to generate thinking identity or consumer behavior. The experience must focus on how to make customers feel through the senses, emotions, thinking, and action. Products and services are linked. Get a unique experience, this unique personal experience, create and satisfy consumers' deeper consumer desires and sympathy. The five forms of Experiential Marketing: sensory experiential marketing, emotional experiential marketing, thinking mode experiential marketing, mobile experiential marketing, and connection experiential marketing.

3. Consumer Behavior

Advertising marketing will allow consumers to generate a series of psychological reactions because of the messages, images, and graphics that are transmitted, as summarized by international marketing expert Heinz M Goldmann, who has an important formula in western marketing knowledge, the Attention and Interest and Desired and Memory and Action (AIDMA) model, which shows the attention, understanding, memory, acceptance, and learning awareness of the consumer's exposure to marketing advertising messages (Howland, Kelley & Janis, 1954). At the same time, because consumers' attitude towards products is trust, persistence, and willingness to purchase, these reactions can be explained by the AIDMA model: this formula can focus on consumers' access to advertisements, pictures, images, messages, etc., until the completion of the complete purchase behavior.

- Awareness: Awareness, as consumers receive the acceptance of advertising marketing, gradually realized that the brand and the object description, display, text, promotion, story marketing, identity, let consumers generate a series of psychological reactions, and begin to pay attention to the goods.
- Interest: Interests are generated. After receiving the advertisement marketing media, the readers will pass the message and attract consumers' attention. They will begin to have interest because of the key words, diagrams and behaviors in the message. Consumer interest is generated, in part, the message is conveyed as a whole to understand proposition, selling and Unique, and the rationality and sensibility in the product or service commodity or the moral appeal. The consumer begins to generate interest, but from a psychological point of view, it must be said that the psychological factors that are of interest are included in the consumer's purchase of the goods and their own interests.
- Desire: Interest and desire are sometimes just a line apart. Consumers have desires must be because the function of goods solves or satisfies consumer's needs. Once marketing advertisements generates desire in every consumer, the success rate will be strengthened.

- Memory: Leaving memories. Apart from seeing the goods and understand the goods, there's nothing more than the memory before the purchase. The memory of goods will also be the entry point for consumers to identify with the brand, and take as a higher brand awareness position.
- Action: In addition to the psychological factors aforementioned, it is followed by execution and decision to purchase. However, before the action, the overall marketing will still force the final consumption. The incentives for consumers to act immediately, such as limited edition, time limit sales, discount volume, and membership, are all actions that need to be pushed in the final action.

The advantage of marketing is that it allows consumers to make purchase decisions without letting consumers pay attention to the AIDMA (attention, interest, desire, memory, and four steps of actions.) Consumer behavior is based on the fact that advertising marketing grasps the interest of the audiovisual public and provokes desire to achieve action (Kotler, P. 2002)

With the consumption habits of Internet and wireless applications, consumers have made great changes in their daily life shopping. Relatively, they have changed the traditional AIDMA to the current AISAS. Two of them are changed by digital marketing, S-SEARCH and S-SHARE. In addition to searching for products, consumers will also share them with others. Because of the use of AI on the technical Internet, it is possible to track the products that consumers have read, searched, and viewed. The Internet will allow consumers continue to deliver more or similar ads to consumers while watching other products or collecting information. However, consumers may not have to go through the AISAS model in order to purchase goods or services. Because different products will also make consumers have different combined reactions.

4. Ogilvy & Mather 360 Degree Brand Stewardship

Brand management is the most important part of the business behind each product. Ogilvy & Mather proposed the brand management thinking of Brand Stewardship in the 20th century. This is a way to transform consumers' feelings about products to a relationship between consumers and brands. The so-called 360 Degree Brand Stewardship is to study the multi-faceted relationship between customers and brands. This includes how consumers approach the brand, consumer experience, a consumer's feelings, consumers' ideas and attitudes, and consumer needs and desires. After these relationships between a consumer and a brand begin, it is better to know whether there is a correct contact, communication and acquisition, to make the information richer, and the relative brand equity must also increase the position of efforts in the heart of consumption. Product itself, reputation, customer relationship, sales comfort, visual identity and overall image. The process of the Ogilvy & Mather 360 Degree Brand Stewardship can be divided into:

- Information Gathering: This is a preliminary health check for the product, understanding the internal and external state, which includes product details, consumer relations, competition and the environment.
- Brand Audit: Brand audit can be said to be a kind of market research, that is, products from the perspective of consumers. Whether it is a positive or negative response, it is the product's own feelings, impressions, contacts, opinions, memories, expectations. Factors such as satisfaction, criticism and disappointment will be the true feelings of consumers on products.
- The Brand Probe: The brand team must thoroughly and objectively see the problem of brand weight, with a broad sample of the brand including loyal consumers, customer representatives, customer brand groups, agent brand groups, and executive activities/promotions/packaging, etc. Representatives participate together. The most important goal is to explore the consumer's attitude towards the brand, the brand's attitude towards the consumer, identify the key attitudes in this relationship, and identify and try to find all the negative points/disadvantages/focuses on the product, in-depth perspective and answer.
- The Brand Print™: When the brand team truly knows a brand and completes the brand test, it can start to enter the so-called Brand Print™. Understand and find the core truths and spirits. From the perspective of learning only the lake, look for the highlights of the brand test. It may just be a sentence or two, or a paragraph or two, but it will allow consumers to see the brand's characteristics in depth and truth. In contrast, such a feature is definitely not fictitious, it must be the product that precipitated in the previous process.
- How to use the Brand Print™: Brand Print™ is a clear road indication for agents or customers to develop the entire brand marketing plan. Such a clear road direction avoids excessive fantasy and personal subjective thinking.
- The Brand Check: This is a simple process of reflection. When the brand achieves marketing or brand positioning and spreads to consumption according to the above process, it must make an introspective review action at a certain time, and can properly maintain the most authentic relationship between the consumer and the brand.

Not every brand can have funds or enough people to do a full body test, but such a 360-degree brand examination will give operators a deeper sense of direction and thinking about their brands and products. In the direction of subsequent marketing, it is not too far from the consumer's true feelings about the brand.

5. Relevant Theory of Advertising Influence

Regardless of the traditional media, digital marketing model, advertising exists in a tool for communication between brands and consumers. At all stages of advertising, consumers are ultimately hoping to achieve or enhance the consumption of brands, goods and services, positioning, and final purchase behavior. To make consumers feel the final product, brand or service, after all, it is inseparable from Cognition, Affect and Behavior. Such an attitude proposed by Mitchell and Olsen (1981) and Shimp (1981), explaining the importance of the Aad structure, using Aad and other advertising effects as a measure, after such a causal relationship affects the brand attitude (Ab) and the intention to buy the brand (PI), the consumer begins to accept the brand, psychological factors such as identity, rejection, etc.

Recently, six scholars Ephron, Harvey, Maroney, Moran, Spaeth, and Brandon collaborated on the media model measured by the Advertising Research Foundation (ARF) in the United States. These eight stages are: the Vehicle Distribution and the Vehicle Exposure, Advertising Exposure, Advertising Attention, Advertising Communication, Advertising Persuasion, Advertising Response, and Sales Response. ARF uses the mutual or individual performance as a starting point. The latter is the psychological reaction of consumers when they face advertising, and the interaction factors after real purchase.

6. Online Advertising Metrics

As the overall media platform moves to the Internet, digital marketing added more metrics, traffic, visits, average time of stay, repeatability, reach, ad exposures, ad search, click, download, share, and returning rate in its analysis. These are all communicating with consumers on digital marketing and collecting or using consumer approval to achieve secondary or repetitive marketing. The ultimate goal of this numeric digital marketing is to accumulate means of brand recognition of positive and negative numbers. This number can be extended to the brand to clearly understand consumer's buying needs, hobbies, trajectories and loyalty. (Wu, H. 2015)

7. Live Streaming

The online live broadcast started from live broadcasting video games. When viewers accepted it more and more, it gradually shifted to expand into the commercial market. Due to the needs of the store operators, the live broadcast contents in Taiwan has changed from sharing personal life stories to a complete business purpose now. The market size has also grown rapidly from NT\$ 500 million in 2014 to more than NT\$ 12 billion in 2017. To understand the channels netizens use to obtain shopping information, the survey of the Market Intelligence & Consulting Institute (MIC) has shown that the top five channels for obtaining shopping information are: shopping websites (54.9%), Google search (40.3%), Facebook (24.3%), price comparison engine (22.5%) and relatives and friends (16.9%). Although LINE did not enter the top five, the proportion increased from 12.3% in 2017 to 15.8% in 2018. For the first time, the communication power surpassed portal sites (14.2%), EDM (12.6%), and TV advertisements (12.4%). Senior industry analyst Zhang Xiaoqi pointed out that the improvement of LINE ranking is mainly due to the active development of various marketing guide services in recent years. (Source: MIC, Market Intelligence & Consulting Institute.) The live streaming itself has the advantages of the Internet: there are no time and space restrictions; one can freely decide whether to watch or not; it is rich in content, interactive, and no geographical restriction. The tools often used in marketing in the beginning were product release commentary, conferences, instant news delivery, unboxing texts, etc. These were originally broadcasted in a single communication mode to the chat blocks currently available on live broadcast platforms. These chat blocks would provide users a space to express with words and emojis to strengthen their sense of belonging and grouping. At the same time, because live videos will continue remain on the platform, these would create two to three marketing spreads, which effectively extends the time that live broadcasts are viewed, and also exerted the maximum value of transmitting the message. At the same time, in response to netizens' preference for live broadcasts, MIC conducted a survey regarding Taiwanese netizens watching live broadcasts. It was found that among the netizens who have used live broadcasts, 71.6% preferred Facebook as the main viewing platform, followed by Youtube (55.2%), Live (19.5%), Instagram (15.6%), and Live.me (10.2%), and so on. The top five reasons for netizens to consider the live broadcast platform or software are "more free contents (47.7%)", "friendly user interface (36.5%)", "multiple program types (28.2%)", "multiple interactive methods (20.4%)", and "has more influencers (18.8%)". In terms of the number of viewers of the live webcast, most people watch it from 17:00 to 24:00, that is in the evening to late night. The time spent on watching live broadcasts falls between 30 minutes to 2 hours.

8. Live Streamer

An online streamer, also known as a live streamer, internet streamer, or streamer, according to Wikipedia, is a person who broadcasts themselves online through a live stream or pre-recorded video. Such a popular career born in the booming industry of live broadcast culture, the technology of audio and video streaming provided a perfect stage for live broadcasters, using simple tools and software to easily become a live streamer, and has a remarkable growth. (Xie Chengfu 2018)

The success of the live streamer depends on the popularity of the streamer him/herself and the characteristics. Such personal characteristics includes emotional, professional, and game-type topics, which can be turned into a topic while live streamers broadcasts. As the number fans increases, the influence on the Internet will also increase.

At the present, the most representative platforms in Taiwan, such as Twitch, Meerkat, Periscope, Taiwan also has 17, livehouse.in, etc., large players such as Facebook, YouTube have also entered the battlefield. The real-time interactivity of the live broadcast has attracted a large number of netizens to watch it, and has also created a number of influencers. From gaming, performing musical talents, and beautiful women big stomach queens, many people have enjoyed watching them eating. Live streams have also been described as "the last straw that crashed TV news," with unlimited potential. (Source: Digital Times, Carat Media Weekly)

Company name	Main business	Go live stream	Type	Purpose	Business model	Advantage / Characteristics
YouTube	Video Website	2011 starts Live Streaming / 2016 starts mobile live streaming	Individual, events, games	Increase user engagement	Advertisement	Stable platform
friDay Video	Video on demand	2013	big events, competitions	Customer service	None	FETnet Group Resources / Combined with audio and video platform for curatorial marketing
Facebook	Social media	2015 August opens up Likes / 2016 February opens up completely	Celebrities, amateur	Extended user stay time / VR layout	Ad	Nearly 1.8 billion monthly active users worldwide / 18 million active users in Taiwan
Yahoo TV	Portal site	2015 soft launch / 2016 July - Official launch	News, Finance, Sports, Lifestyle	Brand image / Extend user retention time / Increase advertising revenue	Ad / Product placement	Taiwan's main portal / Yahoo technology platform and media resources
LINE	Communication Software	2015	Limited to Line accounts	Customer service	One of the official account functions, no extra charge	More than 17 million active users in Taiwan

Source: Digital Times, Carat Media Weekly
Figure 1: Network video platform

However, at the same time, many media messages are transmitted quickly, and there is also a competition relationship between the mass media as a whole. If this is explained by the usage and satisfaction as point of views, viewers under different information content of different media are to satisfy themselves. This psychological need comes from the mutual replacement of different media content.

CASE STUDY

Company A was originally an outdoor media company, because of digital age, it has changed its business sales model to provide clients with more solutions to their sales besides just providing advertising services. By adding digital methods that allows online marketing which presents the characteristics of different products, and a complete product introduction, to directly and indirectly assist clients with the issue of advertising and marketing. Therefore, a Facebook's fan page e-store platform is created. According

to the current overall Taiwanese market, online transactions are high and widely accepted among consumers, and they also trust products sold on e-stores. Company A began to build a platform and have live streamers sell products in real-time. However, Company A has encountered the following problems in its overall operation:

1. The number of people added to FB fans page increased too slowly

Live broadcasts require viewers. The newly created FB fan page requires users to join first before any follow-up push event can be launched. Company A has adopted a large number of gift giving methods to boost the number to reach about 4,000 people in just three months. Once the gift promotion activity stagnates, the number of people ceased to increase instantly. At the same time, it is also found that those who join the company A's FB were oriented by free gifts, when live broadcast sales events started, it was expecting to see an increase in the number of active users, however, the actual response was unexpectedly indifferent, completely insensitive, and would not place any order. The result was that a number of people exist in the fan page, but they would not continue to share contents, and the number of fans would not increase any more.

2. It's not easy to find a live stream host

Currently there are two ways to create live streamers in Taiwan: one is that the person already has his/her personal charm, and the other is to become a streamer after training. But these two kinds of people are difficult to cooperate with company A. If the ones with personal charm goes on live stream on Company A's platform, the number of viewers is still limited, and could not generate as many views as his/her own platform. On the other hand, trained streamers usually are restrained under a contract with the training company, if the person takes projects on his/her own, this can only be limited to just talking and sharing instead of saying products, thus it is difficult to generate substantial sales.

3. Steaming view traffic is not equal to purchase traffic

The point is, after the traffic is brought in, how to make these like-minded people in FB have resonance and actually make purchase. The most difficult problem Company A is facing currently is that the traffic has continued to increase slowly, but it is viewing traffic only. People would not place orders because of quality or price, for each live broadcast event people are all waiting for incentives or giveaways. Therefore, this could not generate good sales revenue.

4. The positioning of the entire e-store is unclear

Positioning has always been an issue that any brand owner must think about first. Company A initially wanted to provide existing customers with a solution to start with, and step into the live streaming e-store business. However, real customer solutions must have complete supporting measures. With no clear positioning, consumers are confused whether to be guided by the e-store itself or by the products, or because of the charm of the live broadcaster, who believes in the product promoted.

CONCLUSION AND RECOMMENDATIONS

In today's era of rich media, consumer behavior is also changing with the times of this digital era. Sting Tao, General Manager of MeMe, once gave an example: a small influencer that has 1,000 faithful fans can make a business of NT\$ 1 million. From this actual market experience, the importance of live streamers is more powerful than the commodity itself. The platform is only a stage of a complete system. According to the foregoing literature, research has found out that consumer behavior is returning to its original position, returning to human nature, and through the Internet, of no geographical and time difference restrictions, live streaming is the next generation's social method, an innovation in the entertainment industry, an indispensable tool for enterprises, and a return to human nature.

This means, the core character that connects people with e-store operators is the live steamer. He/she must have a strong affinity and charisma. The live broadcast topics must combine both the internet industry and entertainment industry. The richness of its content must be adjusted at any time, and with fast speed. Because company A still regards sales as its main purpose, it has been found in the previous literature that good price would not be known to netizens in a closed environment. The incentive for the price will be a major purchase factor, but the source of trust would be shown through the number of traffic.

It is suggested that company A would nurture a professional and dedicated live streamer as the first step. In addition to the professionalism of the original platform system, the number of products, and the evaluation of consumers, the most important thing is communication. Loyal fans would generate high revenue. However, how to find a good live streamer is another issue. We will find out that products might not make you lose the ground, but the operation itself is what would make you win the game. A complete annual planning is the main adjustment strategy. It is not enough to only have good products while doing live streaming. It is important to have the streamer bring in more viewers, these viewers then becomes streamers themselves to share contents out, this is the most important thing for the platform operator to do at the beginning. To start the operation of a platform is hard, and it would have to go through a painful "two-way slow start period", that is, they must first invest resources, find a way to ignite the fire, and then get enough data and feedback to find the right direction.

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Eco-System Oriented Instrument for Measuring Firm Technology Adoption

(Full Paper)

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ABSTRACT

The development of the Firm Technology Adoption Model (F-TAM) of measuring firm technology adoption at the SME level addressed an important knowledge gap from a developing country context. The model, however, lacked a measuring instrument to allow researchers to engage the model empirically. In this study, a measuring instrument is designed, taken through self-review, expert review, focus group discussion, and then a pilot test. Statistical analysis of the pilot test shows that the instrument is both a valid and reliable for measuring SME innovation adoption from an ecosystem perspective. This paper, therefore, opens up new avenues for both industry and academic works on the adoption of digital innovations.

Keywords: F-TAM, measuring instrument, mobile technologies, SME adoption, developing country contexts.

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INTRODUCTION

Industry and academic interest in understanding and promoting the adoption of digital technologies at the firm level is still ongoing (Akman & Turhan, 2018). This interest has intensified in the past couple of years in Ghana (National Communications Authority -NCA, 2016; Bank of Ghana, 2016; Doe, Van de Wetering, Honyenuga, & Versendaal, 2017), a development that heightens the need for context-relevant models (Iqbal & Qureshi, 2012) that explain the adoption of digital technologies. The context-relevant models are significant because studies such as Data (2011) reported that earlier models of technology adoption had realized mixed results when they are tested in developing country contexts. In an attempt to develop a model that illustrates adoption at the micro, small to medium scale enterprise levels in developing country contexts, Doe et al. (2018) contextually validated the Firm Technology Adoption Model (F-TAM) as a more realistic way of measuring firm technology adoption in developing country contexts. A significant setback of Doe et al. (2018), however, was the absence of a measuring instrument (questionnaire) to test that model, just as Technology Adoption Model (TAM), Decomposed Theory of Planned Behavior (DTPB), Unified Theory of Acceptance and Use of Technology (UTAUT), and Integrated Model of Technology Acceptance (IMTA) have had. The lack of an instrument makes the testing of the revised F-TAM a thorny issue, raising such essential questions as:

- a. *What instrument can be applied to measure the firm-level adoption of digital innovations using the F-TAM model?*
- b. *Has the instrument been developed with cognizance of the contexts of SMEs in developing countries?*

This study is positioned to address these research questions and, therefore, aims to develop and field-test a reliable and valid instrument for measuring F-TAM.

THEORETICAL BACKGROUND

Context Of The Study

Developing countries are those that have low to middle income (0 - \$3,255 per capita income) (World Economic Forum, 2015) and described by Bannock (2005) as countries that have reached neither growth of industrialization nor a level of national income sufficient to finance investment for further growth. Ghana falls within this category of country classification due to her lack of domestic savings required to finance investment for further growth, such as the mass adoption of mobile technology innovations. In such countries, SMEs live with the digital divide, which is invariably a poverty gap (Zachary, 2002). The Ministry of Trade in Ghana defines micro to medium-sized enterprises as any organization that employs between 1 to 5 persons to be micro-enterprises, 6 to 29 people with total assets less than \$100,000 as small enterprises and 30 to 99 people with total assets of up to \$1 million as a medium enterprise (Mensah, 2004). SMEs would have to adopt innovations more quickly due to fewer bureaucracies however they are hindered due to inadequate telecommunications infrastructure, lack of

payment options, legal and regulatory issues, trust and security, socio-cultural factors, and lack of skills in the workforce (Karanasios, 2008).

Theories Of Adoption

Innovation is the design or adoption of an idea, physical artifact, conduct, invention, technology, or a process that is new to the adopting unit (Gupta, Tesluk & Taylor, 2007). Digital innovation is an innovation that if enabled by digital technologies. Digital technologies may be disruptive (Christensen, Christensen & Raynor, 2003), such that they create new markets and value, thereby upsetting existing industry structures, and established market leaders (Christensen & Raynor, 2003).

Innovation is adopted at a personal level, firm-level, and societal level (Rogers, 1962). Theories of adoption can also be similarly classified into three groups of personal adoption theories, firm adoption theories, and societal level adoption theories (Doe et al., 2017). Models that are specific to the study of technology at the personal level only include the Integrated Model of Technology Acceptance -IMTA (Venkatesh, Speier & Morris, 2002), Technology Acceptance Model -TAM (Venkatesh & Bala, 2008), Unified Theory of Acceptance and Use of Technology -UTAUT 1 & 2 (Venkatesh, Thong & Xu, 2012), and Dynamic Use Diffusion Model (DUDM) (Shih, Venkatesh, Chen, & Kruse, 2013). Specific models for the study of societal level adoption only include Culture, Policy & Technology Framework (CPT) (Bajaj & Leonard, 2004). At the firm level, models such as Technology, Organization and Environment Framework (TOE) (Tornatzky, Fleischer & Chakrabarti, 1990), Task-Technology Fit (TTF) (Goodhue & Thompson, 1995), and Perceived Electronic Readiness Model (PERM) (Molla & Licker, 2005) have been used to study firm adoption in the past. None of these earlier models attempt to examine how the different levels have any interactive effect. A currently interactive model proposed for use at the firm level is the F-TAM (Doe et al., 2018).

The F-TAM Model

The Firm Technology Adoption Model (F-TAM) was birthed in Doe, Van De Wetering, Honyenuga, & Versendaal (2017) as an initial step toward the development of a context-specific model of firm technology adoption for developing countries. This was done through a systematic literature review and analysis. The F-TAM posited four factors at the personal/employee level, five factors at the firm level and four factors at the societal level that inter-relate to realize firm-level adoption of digital innovations. The initial F-TAM model was however not validated contextually. To examine the degree to which F-TAM reflect the adoption pattern among SMEs in Ghana, and whether changes in the model would make the model more valid, Doe, Van de Wetering, Honyenuga & Versendaal (2018) contextually validated the initial F-TAM model through two rounds of Delphi panel interviews of both academics and industry experts. The validation study (Doe et al., 2018) discovered new constructs and propositions that made the original F-TAM more realistic to developing country SMEs.

The F-TAM model proposes that employee-level variables (personal level factors) of *Perceived Ease of Use*, *Perceived Usefulness*, *Perceived Indispensability*, *Perceived Social Influences*, *Trial Feedback*, and *Employee Self Enhancement Motives* will collectively lead to firm adoption, and influence firm factors of adoption. At the firm level, the revised F-TAM (Doe et al., 2018) decomposes the general firm-level factors into internal organizational factors such as *Technological Readiness*, *Managerial Innovativeness*, *Organizational Readiness*, *Strategic Fit with Operations*, *Ease of Support*, and *Organizational Culture*; as well as firm industry factors such as *Customer Needs/Demand*, *Competitive Pressure*, and *Partner Requirement*. The model posits that these factors will combine at the firm level to influence firm adoption. Societal level factors proposed in the revised F-TAM (Doe et al., 2018) are *Government Policy*, *Government Championship*, *Government Laws*, *Innovation Infrastructure*, *Opinion Leadership*, and *Successive Government Commitment*. The model posits that these factors will, taken together, lead to firm adoption, influence employee factors, influence firm factors and moderate the relationship between firm factors and firm adoption. The revised F-TAM places emphasis on the technology characteristics as a strong influence on individuals, firms, and society at large. These technology characteristics are *Observability*, *Flexibility*, *Complexity*, and *Relative Advantage* (Rogers, 1962). Doe et al. (2018) propose that the characteristics of the innovation/technology will influence employee level factors, influence firm-level factors, and influence societal-level factors.

The significant novelty of the original F-TAM, as well as the revised F-TAM, is that it posits antecedents of firm-level adoption and at the same time scrutinizing for the impact on the individual (employee) adoption and societal adoption. This is viewed as an eco-systems perspective of examining the adoption of an innovation, which is a novel viewpoint of studying adoption at any level.

The eco-system view of adoption has been prompted by researchers on innovation eco-system (Gobble, 2014; Adner, 2006; Groth, Esposito, & Tse, 2015) who emphasise the need to examine innovation as a member of a system of parts that contribute for the innovation to succeed. This view is adapted in examining adoption at the firm level. Thus the eco-system is operationalised in this study as the different levels of adoption and the technology itself.

Theories Of Measurement

Three categories of theories have been posited as a guide in developing measuring instruments. These are the representational, operational, and classical theories. The *Representational Theory* (Stevens, 1959) suggests that numbers can be used in measurement to represent empirical relations between objects. This view is emphasized by Townsend and Ashby (1984) in that "measurement is (or should be) a process of assigning numbers to objects in such a way that interesting qualitative empirical

relations among the objects are reflected in the numbers themselves as well as in important properties of the number system.” In line with this theory, Stevens (1946) distinguishes four scales of measurement: nominal, ordinal, interval, and ratio scales. The *Operational theory* derives from the methodological literatures of Bridgman (1927), who aptly summed up measurement as “a concept is nothing more than a set of operations; the concept is synonymous with the corresponding set of operations”, emphasized by Dingle (1950) as “any precisely specified operation that yields a number”. For the operational theory, numbers do not point beyond themselves to a scale-free realm. For operationists, “science is simply the study of our operations and not the study of a reality that is thought to lie beyond them” (Michel, 1986). The *Classical theory* is emphasized in Fechner’s (1966) assertion that “measurement of a quantity consists of ascertaining how often a unit quantity of the same kind is contained in it”, and Titchener’s (1905) observation that measurement in any natural science is comparing a given magnitude with some conventional unit of a similar kind. Thus, according to this theory, measurement is “the assessment of quantity” (Rozeboom, 1966), the estimation of “how much” (Michel, 1986). Proponents of this theory are only concerned with how much there is of a given attribute (mass, intelligence, etc.)

Instrument Development

In providing guidelines for instrument development, Leeux et al. (2008) identified three stages of developing a finalized questionnaire (instrument), namely: the developmental stage where the subject matter being studied is explored through literature, when cultural and language issues that can affect the instrument are addressed (Cannell, Oksenberg, Kalton, Bischooping & Fowler, 1989); the question testing stage where each question is tested for the principles of a good questionnaire and the dress rehearsal stage where the questionnaire is tested under real survey conditions (Leeux et al., 2008).

Question development

To facilitate consistency in response, Leeux, Hox, and Dillman (2008) provided a framework of asking questions for respondents to answer. Leeux, et al. (2008) argue that, for a respondent to answer a question, the respondent must understand the question, have or retrieve the information needed to answer the question, translate the information into the form required to answer the question and provide the answer by writing, telling, entering or ticking (Leeux et al., 2008). Asking the right questions implies that the interviewer chooses the right vocabulary suited to the target respondents. Such questions must avoid ambiguity, embedded assumptions (Fowler, 2004), and multiple items in questions, while providing an indication of time frame of information required (Leeux et al., 2008). For respondents’ ability to retrieve information needed to answer questions, Schuman & Presser (1981) discusses in detail how researchers can unintentionally ask questions that respondents do not have answers to, causing them to create answers. These, in addition to the need to eliminate recall problems (Tourangeau, Rips & Rasinski, 2000), are essential elements that Leeux et al. (2008) advise researchers to pay heed to in this regard. To facilitate development of appropriate responses, Leeux et al. (2008) suggest that question items must have clear response tasks by having response options that are obvious, matches the question, do not assume regularity and should be mutually exclusive and exhaustive.

Question testing and dress rehearsal

In the words of Sudman and Bradburn (1982), “even after years of experience, no expert can write a perfect questionnaire”. They further recommended that, where a researcher does not have the resources to pilot-test a questionnaire, that researcher needs not to conduct the survey. In the same vein, Van der Zouwen & Smit (2004) observed that even an expert review of a questionnaire can be very different from a field test of the questionnaire. A field test is, therefore, the surest way to validate a research instrument within the comprehension, recall, judgment and response framework (Tourangeau, 1984; Leeux et al., 2008). Testing questions can be formal or informal. Informal testing includes reading questions to oneself, self-interviews (acting as the respondent), and mock interviews (listening to a colleague being interviewed) (Leeux et al., 2008). A formal field test involves administering the questionnaire on a sample of real members of the population (Leeux et al., 2008). Newer methods of questionnaire testing include: expert reviews (Thomas, 2002); systematic reviews (Forsyth, Hubbard & Lessler 1992); respondent debriefing, referred to in the literature as special probes (Oksenberg, Cannell & Kalton, 1991) or frame of reference probing (Demaio, 1984); behaviour coding (Fowler & Cannell, 1996); cognitive interview (Casper, 2004); and focus group discussions (Morgan, 1988; Stewart & Shamdasani, 1990).

Reliability and validity of the instrument

To discern reality (Smallbone & Quinton, 2004) in behavioral research, measurement instruments must be valid and reliable (Drost, 2011). For every construct, a large number of operational definitions are possible. Therefore it takes creative insight, good judgment, and relevant theory to develop the operational definition that is accurate for the study at hand (Leeux et al., 2008). Subsequently, if a measuring instrument is to produce usable data, it needs to pass the reliability and validity tests (Straits & Singleton, 2011).

Reliability of an instrument requires that the instrument can measure an attribute or attitude consistently and dependably (Straits & Singleton, 2011). In other words, reliability is the degree to which measurements are repeatable under different conditions. This is consistency of measurement (Bollen, 1989), the stability of measurement over varied conditions (Nunnally, 1978), and indicated as a reliability coefficient (Rosnow & Rosenthal, 1991). Common methods of evaluating reliability in behavioral research include test-retest reliability, alternative forms, split-halves, inter-rater reliability, and internal consistency. These address the three main concerns in reliability testing of equivalence, stability over time, and internal consistency (Drost,

2011). For a satisfactory level of reliability, Nunnally (1978) suggests that reliabilities of .70 or higher should be sufficient for the social sciences. Nunnally (1978) maintains that increasing reliabilities much beyond .80 is unnecessary.

Validity, on the other hand, refers to the congruence of fit (goodness of fit) (Straits & Singleton, 2011) between the items that seek to measure a construct. Validity measures whether the operational definition and items under a construct indeed measure what the construct means accurately (Combach & Meehl, 1995). In this vein, an unreliable instrument is often not valid (Davis, 1971). The four types of validity researchers must consider are statistical conclusion validity, internal validity, construct validity, and external validity (Drost, 2011).

Theoretical Underpinnings Of Current Study

This current study engages the representational theory to develop an instrument for the context relevant model of F-TAM. This approach is consistent with the instruments associated with other models such as CPT framework, PEERM, and TTF models. In this approach to instrument development, numbers represent an empirical relational system, which exists quite independently of our operations, and are used as a convenience and are, in principle, dispensable. The instrument development followed De Leeux et al.'s (2008) three stages of developing a finalized questionnaire (instrument). These are: I) the developmental stage where the subject matter being studied is explored through literature; II) the question testing stage where each question is tested for the principles of a good questionnaire; and finally, III) the dress rehearsal stage where the questionnaire is tested under real survey conditions.

METHODS

To develop the measurement instrument, we followed Churchill's (1979) process to specify construct domain, generate a sample of items, collect data, purify measure, collect data again, assess reliability, assess validity, and develop norms. Using the domains and variables of Doe, Van de Wetering, Honyenuga, Versendaal, & Boateng (2018), question items for this instrument were either adapted from relevant previous studies, or crafted and were reviewed for length (Holbrook et al., 2006), grammar (Leeux et al., 2008), simplicity (Bhandari & Wagner, 2006), social desirability (Brace, 2004), double-barreled questions (Leeux et al., 2008), and question order (Baker, 2003). The checking process was done through self-review, expert review and focus group discussions (Leeux et al., 2008).

Self-review- The authors went through the adapted or constructed questions one by one to make a judgment on translation validity (face validity and content validity) (Trochim, 2006; Leeux et al., 2008).

Expert review- Two primary goals of an expert review are to reveal problems with a survey instrument so that they can be remedied before going into the field or to sort items into groups that are more or less likely to exhibit measurement errors (Holbrook et al., 2007). Four experienced academic researchers in the areas of technology and innovation adoption also reviewed the questions and gave feedback (Trochim, 2006). This improved the translations validities dimensions of construct validity (face validity and content validity).

Focus group discussion- A focus group of 12 academics (Collins, 2002) in Ghana was conducted as the final stage of the qualitative questionnaire development and review process. The focus group discussion on the questionnaire lasted for two hours. During this session, each participant was allowed to suggest changes to the questionnaire, and it was discussed. Suggestions that were accepted were included in the final questionnaire for field testing. This also further translations validities dimensions of construct validity (face validity and content validity) (Trochim, 2006). Due to the varied background of the focus group participants, this process also enhanced the external validity of the instrument constructs (Trochim, 2006).

Table 1 illustrates the sources of the variables from each construct. A pilot test of this research instrument was necessary to examine the statistical validity of the instrument.

Insert table 1 here. See Appendix B.

The field test of the questionnaire was done as the second phase of the questionnaire validation process (De Leeux et al., 2008). A middle ground of 25 samples was found between pilot study sample size suggestions of 15 to 35 (Fowler, 1995), 25 to 75 (Converse & Presser, 1986), 10 to 25 (Sheatsley, 1983), and 20 to 50 (Sudman, 1983). These samples were taken purposefully from sub business districts in Greater Accra, the most cosmopolitan region of Ghana. Responses were taken within three days. Interviewers were experienced field data collectors. Interviewers were not allowed to change questions (Converse & Presser, 1986).

RESULTS OF THE PILOT STUDY

The results from the data analyzed for the pilot study are shown below:

Validity Analysis

Face validity is deemed to be addressed through the review process of self-review, expert review, and focus group discussions (De Leeux et al., 2008).

To obtain convergence validity, several authors recommend having a minimum composite reliability of 0.7 and a minimum average variance extracted estimate of 0.50 (Gerbing and Anderson, 1988, Hair et al., 2016). From the pilot test, composite reliabilities (CR) ranged from 0.742 to 0.885, and average variance extracted (AVE) estimates ranged from 0.515 to 0.780, all meeting the minimum recommended by Hair et al. (2016) for adequate convergence validity.

Discriminant validity is met by the fact that the square root of the minimum average variance extracted (AVE) is higher than the biggest inter-construct correlation (Fornell and Larcker, 1981; Barclays et al., 1995; Hair et al., 2016). Therefore, each construct is unique and differs from the other constructs in the model. Hence discriminant validity is adequately met.

Reliability Analysis

As a common rule, a reliability coefficient, Cronbach's alpha values, that is greater than or equal to 0.7 is thought to be acceptable and a good indicator of construct reliability (Nunnally, 1978). However, values lower than 0.7 may be acceptable for exploratory research. Hair, Anderson, Tatham, and Black (1998) recommend a cut-off point of 0.6 as the lower limit of acceptability.

Correlation Matrix (Pearson R)

Table 2 presents the results of Pearson inter-construct correlations performed for the pilot data. The results show that the correlations between the twenty-six constructs were mostly positive and significant.

Although some of the correlations were very low or very high, this is to be expected since the constructs used to perform the computations were mainly low-level constructs, which might reveal moderate to high correlations among constructs within the same formative high-level construct. For example, technological factors (a high-level construct) such as flexibility, observability, complexity, and relative advantage mainly had moderate to high correlations between them. Due to the small sample size ($n=25$) used for the pilot study, it is inconclusive to assume multicollinearity or violation of discriminant validity at this pilot study stage.

Insert table 2 here. See Appendix B

CMV Bias Analysis

A principal component analysis conducted on the data gathered for the pilot study, with the extraction of only one factor, showed that the factor accounted for 28.14% of variance explained, which is less than 50% variance, hence common method variance bias is absent from the data (Podsakoff et al., 2003).

KEY FINDINGS

We used a sample of 25 firms for reliability analysis. The overall reliability for the 109-item scale is 0.973, which indicates high internal consistencies and appropriateness of the data instrument (questionnaire) used in this study (Nunnally, 1978). Very high Cronbach's alpha values were obtained for firm adoption (0.836), personal/employee factors (0.874), firm internal factors (0.942), firm external factors (0.927), societal factors (0.937) and technological factors (0.901) scales, respectively. These outcomes indicate high internal consistencies and appropriateness of the data instrument (questionnaire) used in this study (Nunnally, 1978). Furthermore, each of the constructs under firm internal factors, firm external factors, societal factors, and technological factors had Cronbach's alphas of at least 0.6, which is acceptable for an exploratory study.

One of the variables under personal/employee factors, namely perceived indispensability, had Cronbach's alpha < 0.60 . Further analysis suggests that the deletion of the third item under perceived indispensability, which reads as "Mobile money innovation is central for me on the job I do" would increase the Cronbach's alpha to 0.648. Alternatively, a larger sample, or changing the question item would improve the reliability. Below are the reliability assessments for each variable.

Table 3: Reliability Analysis of Adoption

	Number of items	Cronbach's α	Mean	Variance
Firm Level Adoption of MoMo Innovations	5	0.836	3.925	0.158

Table 4: Reliability Analysis of Personal/Employee Factors

Personal/Employee Factors (Cronbach's $\alpha = 0.874$)	Number of items	Cronbach's α	Mean	Variance
Perceived Ease of Use	4	0.808	4.160	0.021
Perceived Usefulness	4	0.787	3.450	0.049
Perceived Indispensability	4	0.591	2.840	0.145
Perceived Social Influences	3	0.786	3.147	0.017
Trial Feedback	4	0.717	3.780	0.062
Empl. Self Interest/Enhancement Motives	4	<i>0.663</i>	3.310	0.071

Utilised Cronbach's alpha < 0.7 ; Bold and Italicised Cronbach's alpha is below the minimum level of 0.6.

Table 5: Reliability Analysis of Firm Internal Factors

Internal Factors (Cronbach's $\alpha = 0.942$)	Number of items	Cronbach's α	Mean	Variance
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Technological Readiness	4	0.903	3.100	0.118
Managerial Innovativeness	4	0.823	3.490	0.084
Organisational Readiness	4	0.745	3.360	0.031
Strategic Fit with Operations	4	0.677	3.320	0.035
Ease of Support	4	0.831	2.780	0.104
Org. Culture (Firm propensity to take risk)	4	0.848	3.680	0.073

Utilised Cronbach's alpha <0.7

Table 6: Reliability Analysis of Firm External Factors

External Factors (Cronbach's $\alpha=0.927$)	Number of items	Cronbach's α	Mean	Variance
Organisational Partner Requirement	5	0.857	3.544	0.023
Competitive Pressure	4	0.825	3.360	0.007
Needs of Customers	5	0.812	3.472	0.086

Utilised Cronbach's alpha <0.7

Table 7: Reliability Analysis of Societal Factors

Societal Factors (Cronbach's $\alpha=0.937$)	Number of items	Cronbach's α	Mean	Variance
Government Championship	7	0.854	3.589	0.024
Government Policy	4	0.823	3.170	0.041
Government Regulation/ Laws	4	0.698	3.170	0.030
Innovation Infrastructure	4	0.753	3.610	0.060
Opinion Leadership	4	0.824	3.610	0.013
Successive Government Commitment	4	0.852	3.500	0.020

Italicized Cronbach's alpha <0.7

Table 8: Reliability Analysis of Technological Characteristics

Technology Factors (Cronbach's $\alpha=0.901$)	Number of items	Cronbach's α	Mean	Variance
Flexibility	4	0.837	3.970	0.016
Observability	4	0.704	3.700	0.054
Complexity	4	0.758	3.230	0.138
Relative Advantage	4	0.674	3.620	0.171

Italicized Cronbach's alpha <0.7

DISCUSSIONS

Tables 3 to 8 show that most of the constructs achieved the minimum reliability index of 0.7 (Nunnally, 1978). However, a few constructs achieved 0.7 through statistical approximation. These are 0.674 (relative advantage); 0.698 (Government Regulation/ Laws); 0.677 (Strategic Fit with Operations); and 0.663 (Employee Self Interest/Self Enhancement Motives), which are also acceptable for exploratory study (Hair, Anderson, Tatham, & Black, 1998). In the case of the constructs under personal/employee factors, perceived indispensability had Cronbach's alpha value of 0.591, which is approximately 0.60 (Hair et al., 1998). The item was left as it is because its reliability could improve using a larger sample size. The authors, therefore, believe that the questionnaire is valid and reliable. The final instrument is shown as Appendix A attached. The F-TAM questionnaire (Measuring instrument) is expected to measure the adoption of digital technology innovations and, by extension, is generalizable to other innovations at the micro, small to medium scale enterprise levels. It may similarly measure the adoption of digital innovations at the large firm-level.

While the academic report on pilot studies is rare in the research literature (VanTeijlingen *et al.* 2001) and sometimes considered a waste of time, the scholarly work of Friedman (2013) justified reporting the results of pilot studies. Meta-analysis studies, for instance, rely on pilot studies as well as empirical studies with large samples (Hazzi & Maldaon, 2015). Strengths and weaknesses of a measuring scale, as well as reasons of failed pilot studies that do not lead to a full-scale study, needs to be reported and understood (Hazzi & Maldaon, 2015). Thus pilot studies also help to design a realistic and workable research protocol. Outcomes of a pilot study enable researchers to decide what critical resources are needed in a more extensive study, persuade more scholars as well as grant reviewers, investigators, and other stakeholders of the relevance of a large study (Leon, Davis, Kraemer, 2011). De Vaus (1993) had also made a recommendation summarised as "Do not take the risk. Pilot test". To substantiate this trend of thought, Hazzi and Maldaon (2015) report that, from their experiences, the measurement of a construct must proceed through the conduct of (a) a pilot study first considering the issue of checking the reliability with Cronbach's alpha; (b) the main study considering reliability again, and reporting the results; (c) comparing those results (the pilot and main study); and (d) deletion of items, which have common problems of reliability. The significance of this study, therefore, is that it provides a tested measuring instrument that examines firm technology adoption from an eco-system perspective. This is significantly different from other instruments that have been used in measuring firm adoption of any innovation.

CONCLUSIONS & RECOMMENDATIONS

This study sought to develop and field-test a reliable and valid instrument for measuring firm technology adoption using variables in the F-TAM. The study went through the instrument developmental stage, the question testing stage, and the dress rehearsal stage (De Leeuw et al., 2008). At the end of the process, reliability values for all constructs were within the acceptable limits of ≤ 0.6 , for exploratory studies. The instrument is, therefore, valid and reliable for measuring the F-TAM in a developing country context. The research gap identified is filled.

Further research on investigations on the factors that engender the adoption of digital innovations in developing country contexts can now be done with the F-TAM, using a reliable instrument. In applying this instrument, however, we suggest the use of larger samples. Further studies may discriminate between micro firms, which are mostly non-formalized and small to medium firms that are more formalized. The instrument reported in this study is currently most useful in developing country contexts. Users of this instrument need to ensure congruence between the contexts of Ghana and the socio-economic development, and e-readiness contexts within which this may be applied. The instrument is not applicable under mandatory adoption conditions that may exist for some firms. It applies in voluntary firm-level adoption conditions, which the F-TAM was developed for. This paper is the first attempt to develop an independent scale to measure the adoption of digital technologies in a developing country context at the SME level. We recommend further studies in testing the F-TAM model, using this instrument.

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Appendix A: F-TAM QUESTIONNAIRE

NB:1= Strongly disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly agree

Firm-Level Adoption Of Mobile Money Innovations

My firm has officially adopted mobile money technology for business purposes
Our employees know how to process mobile money payments
Our employees know that mobile money is acceptable in the firm
Our customers are able to make payment with mobile money
We are able to pay our suppliers with mobile money

Personal /Employee factors

Perceive ease of use (PEOU)

I am confident in using mobile money innovations
Using mobile money innovation does not require a lot of my mental effort
I find mobile money innovation to be less stressful
I find it easy to get mobile money innovation to do what I want it to do.

Perceived usefulness (PU)

Using mobile money innovation makes me efficient at the job I do
Using mobile money innovation for my job increases my productivity.
Using mobile money innovation enhances my effectiveness in the job I do
I find mobile money innovation to be valuable for the job I do

Perceived indispensability (PI)

Without mobile money innovation, I cannot function well in my job
Mobile money innovation is a necessity for me
Mobile money innovation is central for me in the job I do
Working without mobile money innovation will be difficult

Perceived social influences

People who influence my behavior think that I should use mobile money innovation for my business/job
People who are important to me think that I should use mobile money innovation
My industry leaders encourage the use of mobile money innovation

Trial feedback

I can easily get information on how mobile money works
I still use mobile money because I don't have any negative experience with the usage
I have tried money in the past before using it in the firm
Before my firm adopted it, I had had a good experience with mobile money usage

Employee self interest/ self enhancement motives

I use mobile money innovations to create a good impression on others in the firm
I use mobile money innovations because it enables me to perform better on my job
The use of mobile money innovations helps me get more promotions due to efficiency
The use of mobile money innovations helps me get more sales due to efficiency

Firm Internal Factors

Technological readiness

In my firm (company) we have sufficient technological resources to implement mobile money innovation
We allocate a percent of total revenue for mobile money innovation implementation
We have the required technology infrastructure to use mobile money innovation
We have knowledgeable persons to use mobile money innovation

Managerial innovativeness

In my firm, top management of our organization are creative in their methods of operation
Management actively seeks innovative ideas
My top management is willing to take risks involved in the adoption of innovations such as mobile money
Top management actively introduce improvements and innovations in our organization

Organizational readiness

My organization is ready to embrace new mobile money innovations
My organization has a formal strategic plan for mobile money innovations use

My organization has a set of clear priorities for our mobile money innovation
My organisation commits personnel to the adoption of mobile money usage

Strategic fit with operations

Mobile money innovation services are compatible with existing technological infrastructure of my company
Customization of mobile money innovation services is easy
The changes introduced by mobile money innovation are consistent with existing practices in my company
Mobile money innovation is compatible with the firm's existing format, interface, and financial transactions

Ease of support

Staff levels of understanding was substantially improved after going through the training on mobile money innovation
The company provides staff training in using mobile money innovations
The training given to employees gives them confidence in the use of mobile money innovation
It is easy to get technical assistance in using mobile money in the firm

Organizational culture (Firm propensity to take risk)

Employees in our organization are encouraged to take calculated risks with new ideas
Our organization emphasizes exploration of opportunities
Our organization emphasizes experimentation for opportunities
Our organization is open to new ideas

Firm External Factors

Organization partner requirements

Our partners need us to use mobile money innovation during our transactions
It is mandatory to use mobile money innovations in dealing with our partners
It is easier to use mobile money innovation in dealing with our partners
Our partners prefer to use mobile money innovation for payment and receipts
The easiest way to do a financial transaction with partners is mobile money innovations

Competitive pressure

We are aware of mobile money innovation implementation in our competitor organizations
We understand the competitive advantages offered by mobile money innovation in our industry
Our competitors will gain a competitive advantage over us if we do not implement mobile money innovation
We will be left behind in this industry if we do not implement mobile money innovations

Needs of customers

Our customers need us to use mobile money innovation during our transactions
It is easier to use mobile money innovation in dealing with our customers
Our customers prefer to use mobile money innovation for payment
The easiest way for financial payment by customers is a mobile money innovation
The only way to receive payment from our customers is to use mobile money innovation

Societal Factors

Government championship

Government's drive for mobile money innovations applications will make us adopt further applications
When government promotes mobile money innovations as opportunities for the future, we are more likely to adopt it
When government removes obstacles for using mobile money, we are more likely to adopt further applications
Government expresses strong conviction about the potentials of mobile money innovation
Government points out reasons why the mobile money innovation is needed
Government shows persistence in overcoming mobile money innovation obstacles
Government gets key decision makers involved in mobile money innovation

Government policy

Government policy on mobile money innovations gives us the confidence to adopt it
Government is proactive in making mobile money acceptable for trading
The existing policies on mobile money are favourable
The taxes on mobile money usage are manageable

Government regulations/ laws

The laws of Ghana support mobile money innovations
If Ghanaian laws prohibit mobile money innovations, we will not adopt it
If any mobile money transaction goes wrong, we are sure of getting recourse in the law courts
We have confidence in mobile money transactions because the government has laws that regulate it

Innovation infrastructure

There is enough infrastructure in Ghana for mobile money innovations
 The banks are ready to support mobile money applications
 Mobile money innovation can be deployed on any mobile phone type
 The telecom companies have enough infrastructure to support mobile money applications

Opinion leadership

In general opinion leaders and the media talk about mobile money innovations very often
 When the media discusses mobile money innovations, we get a great deal of information
 Apart from my organization's stake holders, we are likely to seek information from other people about mobile money
 In the discussion of mobile money, my organization is likely to listen to expert opinion

Successive government commitment

Since 2005, all governments that come to power give attention to mobile money operations in Ghana
 No government can afford to neglect mobile money operations in Ghana
 Mobile money operations are too important for any government to ignore
 We adopt mobile money because every governments will support its use

Technology Characteristics**Flexibility**

Mobile money is a flexible payment option
 Mobile money is readily adaptable to our business processes
 With mobile money, our organization became more flexible with customers
 We quickly meet many of our financial obligations using mobile money

Observability

We have had evidence of how mobile money helped organizations to succeed
 It is easy to discern how mobile money works
 It is easy to observe how mobile money makes transactions flexible
 The growth of mobile money innovations usage by other firms is easy to observe

Complexity

Mobile money innovations are flexible to interact with (-)
 Using mobile money innovations exposes the firm to the vulnerability of digital innovation breakdowns and loss of data
 When we use mobile money, we find it difficult to integrate our existing work with the existing formats of business.
 When we perform many tasks together, mobile money innovation takes up too much of our time

Relative advantage

Using mobile money innovations, we can scale up our financial requirement when needed
 Using mobile money innovations, we can execute payment any time and from any place
 Performance of mobile money innovation services does not decrease with a growing user base
 In using mobile technology innovations, we need not to maintain our IT infrastructure

Appendix B. Table 1: Sources of the variables from each construct in the F-TAM model

Domain	Constructs (F-TAM)	Number of items	Source of items/	Usage mode
Firm Adoption	Firm Adoption	5	Authors	Self-constructed
Personal factors	<i>Perceive Ease of Use (PEOU)</i>	4	Venkatesh and Bala (2008)	Adapted
	<i>Perceived Usefulness (PU)</i>	4	Venkatesh and Bala (2008)	Adapted
	<i>Perceived Indispensability (PI)</i>	4	Shih, Venkatesh, Chen, and Kruse (2013)	Adapted
	<i>Perceived Social Influences (PSI)</i>	3	Shih, Venkatesh, Chen, and Kruse (2013)	Adapted
	<i>Trial Feedback</i>	4	Rogers (1962)	Adapted
	<i>Employee Self Interest/ Self Enhancement Motives</i>	4	Yun, Takeuchi, and Liu (2007)	Adapted
	Firm Internal Factors	<i>Technological Readiness</i>	4	Molla and Licker (2005) Tornatzky, Fleischer, and Chakrabarti (1990)	Adapted

	<i>Managerial Innovativeness</i>	4	Molla and Licker (2005), Tornatzky, Fleischer, and Chakrabarti (1990)	Adapted
	<i>Organizational Readiness</i>	4	Tornatzky, Fleischer, and Chakrabarti (1990)	Adapted
	<i>Strategic Fit with Operations Ease of Support</i>	4	Goodhue and Thompson (1995)	Adapted
		4	Grandon and Pearson (2004)	Self-constructed
	<i>Organizational Culture (Firm propensity to take the risk)</i>	4	Tornatzky, Fleischer, and Chakrabarti (1990)	Adapted
			Škerlavaj, Song, and Lee (2010)	
Firm External Factors	<i>Organization Partner Requirements</i>	5	Iacovou, Benbasat, and Dexter (1995) Dimaggio and Powell (1983)	Self-constructed
	<i>Competitive Pressure</i>	4	Rogers (1962) Soares-Aguiar and Palma-Dos-Reis (2008)	Self-constructed
	<i>Needs of Customers</i>	5	Hauser, Tellis, and Griffin (2006), Lin, Tan and Geng (2013)	Self-constructed
Societal Factors	<i>Government Championship</i>	7	Howell, Shea, and Higgins (2005)	Self-constructed
	<i>Government Policy</i>	4	Bajaj and Leonard (2004)	Self-constructed
	<i>Government Regulation/ Laws</i>	4	Bajaj and Leonard (2004)	Adapted
	<i>Innovation Infrastructure</i>	4	Tornatzky and Fleischer (1990)	Self-constructed
	<i>Opinion Leadership</i>	4	Rogers (1962)	Adapted
	<i>Successive Government Commitment</i>	4	Mathews (2012)	Self-constructed
Technology Characteristics	<i>Flexibility</i>	4	Rogers (1962)	Adapted
	<i>Observability</i>	4	Rogers (1962)	Adapted
	<i>Complexity</i>	4	Rogers (1962)	Adapted
	<i>Relative Advantage</i>	5	Rogers (1962)	Adapted

Appendix B Table 2 Correlation Matrix of all constructs

Constructs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1. Firm Level Adoption	1.00																									
2. Perceived Ease of Use	0.21	1.00																								
3. Perceived Usefulness	0.13	0.24	1.00																							
4. Perceived Indispens.	0.31	0.14	0.30	1.00																						
5. Perceived Soc. Influen.	0.19	0.22	0.71	0.40	1.00																					
6. Trial Feedback	0.00	0.03	0.41	0.34	0.64	1.00																				
7. Employee Self Interest	-0.06	0.22	0.64	0.32	0.73	0.46	1.00																			
8. Technological Readiness	0.06	-0.01	0.27	0.15	0.48	0.26	0.42	1.00																		
9. Managerial Innovativeness	0.22	0.36	0.29	0.38	0.44	0.30	0.48	0.74	1.00																	
10. Organisational Readiness	0.09	0.09	0.38	0.22	0.63	0.37	0.52	0.69	0.62	1.00																
11. Strategic Fit with Operations	0.19	-0.01	0.38	0.60	0.59	0.27	0.56	0.67	0.58	0.74	1.00															
12. Ease of Support	0.07	0.14	0.50	0.01	0.53	0.37	0.48	0.71	0.50	0.69	0.59	1.00														
13. Org. Culture	0.05	0.19	0.14	0.33	0.56	0.31	0.44	0.72	0.65	0.74	0.66	0.44	1.00													
14. Org. Partner Requirements	0.25	0.09	0.26	0.47	0.49	0.24	0.32	0.69	0.62	0.83	0.74	0.49	0.81	1.00												
15. Competitive Pressure	-0.12	0.02	0.32	0.54	0.50	0.30	0.52	0.61	0.50	0.59	0.65	0.31	0.76	0.75	1.00											
16. Needs of Customers	0.07	-0.02	0.45	0.41	0.67	0.35	0.61	0.81	0.62	0.71	0.75	0.62	0.70	0.74	0.78	1.00										
17. Government Championship	0.09	0.10	0.60	0.43	0.66	0.51	0.62	0.45	0.52	0.67	0.74	0.63	0.50	0.49	0.50	0.51	1.00									
18. Government Policy	0.33	0.13	0.34	0.22	0.70	0.51	0.51	0.35	0.37	0.49	0.33	0.40	0.31	0.29	0.29	0.48	0.37	1.00								
19. Government Regulation	0.48	0.02	0.32	0.31	0.60	0.38	0.32	0.57	0.35	0.45	0.51	0.48	0.32	0.39	0.34	0.55	0.38	0.74	1.00							
20. Innovation Infrastructure	0.37	0.09	0.36	0.05	0.49	0.26	0.20	0.35	0.23	0.23	0.20	0.36	0.11	0.16	0.18	0.34	0.17	0.76	0.75	1.00						
21. Opinion Leadership	0.30	0.28	0.45	0.24	0.67	0.38	0.61	0.50	0.57	0.54	0.39	0.38	0.49	0.45	0.48	0.55	0.37	0.80	0.59	0.71	1.00					
22. Successive Government Commitment	0.47	0.19	0.40	0.02	0.47	0.33	0.35	0.44	0.41	0.25	0.28	0.41	0.21	0.11	0.09	0.19	0.47	0.52	0.67	0.64	0.60	1.00				
23. Flexibility	0.45	0.18	0.30	0.36	0.43	0.01	0.28	0.11	0.24	0.15	0.28	0.03	0.27	0.28	0.34	0.32	0.19	0.51	0.41	0.54	0.54	0.32	1.00			
24. Observability	0.36	0.39	0.28	0.39	0.68	0.40	0.41	0.31	0.50	0.32	0.39	0.22	0.43	0.24	0.27	0.37	0.42	0.65	0.63	0.54	0.53	0.53	0.63	1.00		
25. Complexity	0.31	0.44	0.19	0.29	0.45	0.37	0.22	0.12	0.44	0.26	0.12	0.16	0.27	0.20	0.23	0.21	0.32	0.62	0.44	0.54	0.54	0.37	0.41	0.61	1.00	
26. Relative Advantage	0.27	0.47	0.30	0.26	0.51	0.27	0.47	0.08	0.31	0.41	0.29	0.33	0.31	0.23	0.25	0.18	0.54	0.72	0.43	0.47	0.60	0.46	0.53	0.60	0.65	1.00

Effects of Gamification Elements on Crowdsourcing Participation: The Mediating Role of Justice Perceptions

(Full Paper)

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ABSTRACT

Justice perceptions have been regarded as an important influencing factor for solvers' (i.e., users who solve tasks on the crowdsourcing platforms) continued participation in crowdsourcing. However, researchers and practitioners still lack of sufficient understanding on the design of crowdsourcing platform that can effectively foster solvers' justice perceptions. By synthesizing theory of organizational justice and the literature on gamification, we examine the effects of solvers' gamification element perceptions on their crowdsourcing participation through justice perceptions. Specifically, we propose a research model to explain the effects of three gamification element perceptions (i.e., point, feedback, social network) on solvers' distributive, interactional, and informational justice perceptions which, in turn, foster their crowdsourcing participation. By collecting survey data from 295 solvers and analyzing the data with the partial least squares-structural equation modeling (PLS-SEM) approach, our study finds that point fosters crowdsourcing participation through distributive and interactional justice. Feedback enhances participation through distributive, interactional and informational justice. While social network strengthens participation via interactional and informational justice. Our study offers significant theoretical contributions and practical implications for the gamified crowdsourcing and organizational justice literatures.

Keywords: Gamification, Crowdsourcing, Organizational Justice Theory, Distributive justice, Interactional Justice, Informational Justice, Point Perception, Feedback Perception, Social Network Perception

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INTRODUCTION

Crowdsourcing platforms are prevalent online cyberspaces where organizations can source their tasks from a large number of solvers (Ye *et al.*, 2017). As reported by the World Bank, the global crowdsourcing market reaped \$2 billion revenue in 2013 and the number is estimated to reach between \$15 billion and \$25 billion by 2020. Crowdsourcing platforms enable firms to solve tasks with lower costs and collect consumer reviews about new products or services (Boons *et al.*, 2015). However, active solvers remain extremely low in such platforms. For instance, InnoCentive, a well-known crowd market, has only about 6,000 active solvers (approx. 1.6% of total registered solvers). A prominent reason for the lack of active participation in the crowdsourcing platforms is the insufficient justice perceived by the solvers, as evidenced in the crowdsourcing contests of Moleskine and Henkel (Faullant *et al.*, 2017). The Facebook page of Moleskine was occupied by thousands of negative comments from designers, customers and fans who are dissatisfied with the company's new incentive scheme for crowdsourcing, as this scheme only monetarily remunerated the winner. For another instance, Henkel, a company which held crowdsourcing contest for ideas, also received hundreds of complaints from the participants who are disappointed with the winner selection decision. And the contest winners felt that they were over-ruled.

Prior evidences demonstrated that in addition to monetary incentives, solvers also value fairness; and disappointment may occur because of perceived unfair treatment (Faullant *et al.*, 2017). It has been found that unfairness perceptions in crowdsourcing contests could stem from unfair reward allocations, nontransparent winner selection criteria, impolite atmosphere and disrespectful communication style (Franke *et al.*, 2013; Gebauer *et al.*, 2013). Specialized enterprises and their wage minimization have the function of increasing distributive fairness, enhancing transparency and resolving disputes from the source. The resolver's understanding of the terms and conditions of the crowdsourcing system, as well as the organization's distributive fairness and procedural fairness, can further influence their willingness to contribute to the organization. However, crowdsourcing research sheds little lights on how to build crowdsourcing platforms that can effectively attenuate solvers' perceived unfairness.

Gamification elements, for example points, badges, and leaderboard, have been regarded as effective non-monetary incentives within organizations (Mollick & Rothbard, 2014). It has been argued that gamification elements can act as non-monetary rewards that influence employees' justice perceptions, which further foster their organizational citizenship behaviors (Abdullah

& Wan, 2013). Applying this logic to the context of crowdsourcing, gamification elements might work as non-monetary incentives (Mekler *et al.*, 2017) that affect solvers' justice perceptions and promote their participation. However, there is scant research examining such potential effects. Without a nuanced understanding on the causal links among gamification elements, justice perceptions and solvers' participation, it would be difficult for crowdsourcing platform operators to properly develop gamification elements that enhance solvers' justice perceptions and foster their participation. Thus, this study aims to fill this gap by answering the research questions: *How do gamification elements affect solvers' justice perceptions and hence their participation in crowdsourcing?* Based on the organizational justice theory and the gamification literature, we develop a research model illustrating the impacts of solvers' perceptions about gamification elements on their crowdsourcing participation via justice perceptions. We propose that solvers' perceptions of three gamification elements, i.e., point, feedback, and social network will positively affect their distributive, interpersonal and informational justice perceptions, which in turn affect their crowdsourcing participation. In general, this study enriches the crowdsourcing literature by empirically examining the impacts of gamification on solvers' participation through their justice perceptions. It will also contribute to the gamification literature by offering a new angle of understanding the effects of gamification on user behaviors.

The remaining sections of this paper is organized as follows. Firstly, we introduce the theoretical background of this paper, i.e., the theory of organizational justice and the literature on gamification. Building on the theories, we propose our research model and hypotheses accordingly. Then, we describe the methodology as well as results of data analysis. Finally, we review and discuss our findings and offer both theoretical contributions and practical implications.

THEORETICAL BACKGROUND

Organizational Justice Theory

According to the theory of organizational justice, justice refers to perceptions of fairness and assessments on the adequacy of performance outcomes or processes (Cropanzano & Greenberg, 1997). Recently, theoretical development on this theory has focused on identifying and distinguishing diverse dimensions of justice such as distributive justice, procedural justice, interpersonal justice, informational justice (Greenberg, 1993). Distributive justice centers on assessing the fairness of the economic and social emotional outcomes that individuals receive, while procedural justice refers to the justice of the processes and procedures used to make decisions about the outcomes. Researchers extracted the interactive aspects of procedural justice and conceptualized them as interactional justice (Beth and Mog 1986). Later, the interactional justice was further divided into two subcategories (i.e. interactional justice and informational justice) (Greenberg, 1993). Interactional justice reflects whether the authority or superiors treat the subordinates with courtesy, whether they consider the dignity of the other party, and whether they respect each other in the execution of the procedures or the outcomes of the decisions. It emphasizes the fairness of interpersonal relationship that people feel during the execution of decision-making. Besides that, informational justice reflects the sufficiency of explanation behind the process and outcomes (Greenberg, 2001). It mainly refers to whether the information is conveyed to the parties. That is, to provide some explanations to the parties, such as why some form of procedure or why to distribute the results in a certain way (Greenberg, 2001).

The Organizational Justice Theory (OJT) mainly assumes that users with a high sense of justice will build trust and satisfaction in an uncertain organizational environment, thereby enhancing users' reciprocity and loyalty to the organization. Information systems researchers widely use OJT to analyze the individual's perceptions of justice when using information systems. Some research has been conducted from the perspective of justice to investigate online crowdsourcing participation. These studies focus on the effects of perceptual justice on the behavior and outcomes of solvers, such as creativity (Franke & Klausberger, 2009), product interest and perceived product innovation (Faullant *et al.*, 2017), and the efforts expended by solvers (Franke *et al.*, 2013). For example, Zuo *et al.* (2015) proposes that the solvers' perceptions of distribution, procedures, and interactive justice have a positive impact on their creative performance, which is regulated by ideological cooperation and conceptual generation. Another example is Faullant *et al.* (2017). They found that solvers' justice perceptions can enhance their product interest, perceived innovation and loyalty intentions. However, relatively few studies have further explored the antecedents of justice perceptions. For example, Fieseler *et al.* (2017) conducted a qualitative survey of 203 solvers on Amazon Mechanical Turks, and put forth some suggestions for improving their sense of fairness. They found that the fairness of distribution can be improved with specialization and minimum compensation; increased transparency and resolved disputes. And worker representatives can increase both procedural justice and procedural justice; humanization can promote interaction equity. To give another example, Frank *et al.* (2013) based on two experimental simulations and argued that the crowdsourcing systems' terms and conditions and the prior identification level with the organization affect the solver's perception of distribution equity and procedural fairness, which in turn affects their willingness to contribute to the organization. In addition to these few studies, some studies suggest that gamification design elements may also affect fairness (Callan *et al.*, 2015; Mollick & Rothbard, 2014). In this study, we follow this research direction and explore the drivers of justice perceptions of solvers from the perspective of gamification design. We believe that gamification elements may play an effective role in enhancing solver's sense of justice.

Effects Of Gamification Elements On Solver Participation

For the definition of gamification, Deterding *et al.* systematically explained that the essence of gamification is "using game design elements in non-gaming situations" (Deterding *et al.* 2011). Gamification is used in the field of education at the very beginning. And its mechanism aims to improve students' enthusiasm for learning. Recently, information systems scholars adopted and developed the concept of gamification to design incentives for the use of information systems (Hamari *et al.*,

2016). They define gamification in information systems as using gamification design elements in information systems to improve or change an individual's attitudes and use of the system (Liu et al., 2017).

After gamification was introduced into information systems, academic research on gamification has surged. Koivisto & Hamari (2019) systematically analyzed 273 empirical studies and identified 47 different gamification affordances. They then divided these gamification affordances into several categories, among which three are most important (i.e., achievement, social, and immersion). The first "Achievement affordance" category includes gamification elements such as points, scores, missions, badge, leaderboards, levels, timer, feedback, etc. The second category concerns with social interaction elements, including social networking features, cooperation, teams, competition, etc. And the third "immersion affordance" category includes avatar, character, narrative, dialogues, theme, virtual world, 3D world, roleplay and other elements (Koivisto & Hamari, 2019). Subsequently, through the investigation of online gamified communities established by Xiaomi and Huawei, Xi & Hamari (2019) studied the effects of users' interaction with three types of gamification features (achievement-related, immersion-related and social-related features) on their intrinsic need satisfaction. Results of this study showed that when users interact with achievement-related and social-related features, their inherent needs for autonomy, competence and relatedness are more likely to be met. However, when users interact with immersion-related features, only self-satisfaction can be improved. Based on their findings, organizations should design different gamification features according to their business goals and targets of different consumer needs. For instance, education training institutions can improve user participation through constantly motivating the inner motivation of the participants and helping them form long-term study habits. In contrast, crowdsourcing platform can improve solvers' participation by offering additional incentives beyond monetary rewards, such as point, feedback, and social networks.

Gamification is also used in the context of online crowdsourcing to enhance the psychological and behavioral outcomes of the solvers (Morschheuser et al., 2017). To promote user engagement, a large number of gamification elements have been designed into the crowdsourcing platforms, such as points, feedback, badges, leaderboard, levels, and progress, etc. (Morschheuser et al., 2017). In general, the crowdsourcing platform equipped with gamification design is more popular among users. Previous research has pointed out that gamification elements can enhance the willingness of the solvers to continue to participate by affording their motivations (e.g., Feng et al. 2018; Goh et al. 2017). Motivations can be classified into intrinsic motivations and extrinsic motivations (Ryan & Deci, 2000). On the one hand, many studies have found that if gamification elements are added to the crowdsourcing platform, it can be seen as a design shifting participants from the completion of task to participation driven by intrinsic motivation (Deterding et al., 2011; Feng et al. 2018). Given that the success of crowdsourcing contests relies on a great number of participating solvers, the crowdsourcing platforms design inspiring elements to enhance participation by drawing on the ideas of the game. For example, Goh et al. (2017) found that reward points and badges can meet the motivational needs of autonomy and competence in mobile crowdsourcing. Similarly, Blohm & Leimeister (2013) found that providing points in crowdsourcing is a way to enhance participants' sense of mobility and immersion, further motivating them to complete tasks. Based on the perspective of motivational affordance, Feng et al. (2018) found the intrinsic needs of self-expression, self-efficacy, and playfulness can be met by both point and feedback elements, which further motivate the solvers to participate in micro-task crowdsourcing. Apart from that, some gamification elements are found to satisfy solvers' extrinsic needs for reputation or recognition, thereby stimulating their participation (Blohm & Leimeister, 2013). Studies have shown that various intrinsic and extrinsic motivations instigate people to join in crowdsourcing contests. For example, the intrinsic motivation engendered by the task design allows the participant to have the creativity and autonomy to develop his or her skills and sensory abilities. And in some cases, the extrinsic motivation for economic return can also be promoted. Specifically as an example, Zheng et al. (2011) discovered that individual's motivations can be enhanced by task complexity, task granularity, and task diversity (Zheng et al. 2011).

In addition to the widely accepted "gamification-motivation-behavior" logic, previous research suggests that some gamification elements (e.g., points, badges, leaderboard, social network) act as effective non-monetary incentives to compensate the solvers' efforts and improve their sense of fairness, thereby motivating them to make more contributions (Kawajiri et al., 2014). So it's an effective way to certify the solver's efforts through rewarding points. Badges and leaderboard also remunerate the efforts of solvers in a similar way. Apart from this traditional PBL-triad (i.e., points, badges, leaderboards), both positive and negative performance feedbacks from crowdsourcing firms can serve as useful mechanisms to recognize the solvers' efforts. Additionally, social networking on crowdsourcing platforms allows the solvers and crowdsourcing firms to communicate at any time, which makes the solvers feels respected. According to organizational justice theory, when employees feel that their employers treat them fairly, employees will commit to their organizations and conduct organizational citizenship behaviors (e.g., working hard) (Greenberg, 1993). In the context of crowdsourcing, as effective non-monetary incentives, gamification elements (e.g., points, feedback and social network) can be used by crowdsourcers to strengthen the solvers' sense of justice and maintain their participation. However, in both the gamification and crowdsourcing literature, few studies have attempted to link gamification elements to solvers' sense of justice and participation behaviors.

In the online crowdsourcing platform of the current study, we only choose the gamification elements of the achievement and social categories. There are two reasons why we only choose these two categories. First, the immersion category is more related to self-perceptions, rather than justice perceptions. Second, the gamification elements in the immersion category are not presented in this platform. In the platform we study, scores, missions, badges, leaderboard, and timer are not presented, and solver levels overlap with points as the levels are based on points earned. Therefore, we specifically choose to focus on point

and feedback for the achievement category. Besides, as individual solvers in this platform compete individually for the tasks, there are no team-based cooperation and competition among the solvers. Hence we select the social networking features for the social category. To sum up, in the current study, we pay special attention to points, feedback and social network, and empirically test their impacts on the solvers' sense of justice and participation behaviors.

Points are usually rewarded for successful completion of a given activity in a gamified environment and use numbers to represent the player's experience and abilities (Morschheuser et al., 2017). In this study, solvers will receive points when they participate and win the tasks. As the number of points is a key criterion for crowdsourcing firms to choose the winners of the tasks, points represent a type of non-monetary incentive, recognizing the effort and competence level of the solvers. Only when individuals pay attention to gamification elements can they work. Because individuals' perceptions are different, it is vital to conceptualize gamification elements as perceptions for the generalization of our research results. Therefore, we conceptualize the gamification elements as solvers' perceptions. *Point perception are defined as solvers' perceptions that the crowdsourcing platforms can effectively compensate their work with points.*

In addition to points, the crowdsourcing firms also provides feedback on the performance of the submissions (Ye & Kankanhalli, 2017). A normal crowdsourcing appeal typically receives up to thousands of submitted solutions. Therefore, crowdsourcing firms may not provide feedback to all the submissions. When receiving performance feedback from a crowdsourcing firm, whether it is positive or negative, the solver will feel that his efforts have been recognized by the company, thus forming a sense of fairness. Therefore, the feedback represents another non-monetary stimulus, which can enhance solvers' sense of justice. Therefore, *feedback perception is defined as the solvers' perception that the crowdsourcing platform allows them to receive performance feedbacks from the firms.*

Aside from points and feedback, social networking elements (e.g., live chat, in-mail) are also designed into the crowdsourcing platform. Social networks can promote low-cost information exchange and build meaningful social relationships among users. Communication and conversation can provide people with a stronger sense of connectivity and belonging. When solvers use social networks to build stronger social relationships with crowdsourcing firms, they are more motivated to accomplish tasks and perform well. For example, there is a live chat window in the platform, which is convenient for the crowdsourcing firms and the solvers to communicate the task requirements and progresses in real-time. This makes the solvers feel respected and feel interpersonal justice. And getting information from such channels also enhance the perception of informational justice as solvers would feel that they can access enough information before completing the tasks. Combining the above, this study conceptualizes the perception of three gamification elements as point perception, feedback perception and social network perception, and tests their roles in stimulating solvers' participation through justice perceptions.

As far as the concept of justice is concerned, procedural justice involves the fairness of a decision-making process or procedure. Therefore, procedural justice is concentrated on the process of making the final decisions/results (Greenberg, 2001). These three gamification elements are related to either the outcome (i.e., points, feedback) or the requirements/progress debriefing (social network). Therefore, in this study, when we focus on points, feedback and social networking as three gamification elements in the crowdsourcing platform, we specifically focus on three dimensions of justice, namely, distributive justice, interactional justice and informational justice when studying the effects of gamification elements on solvers' participation.

RESEARCH MODEL AND HYPOTHESES

According to the organizational justice theory and gamification literature described above, we create a research model to illustrate the antecedents for solvers' participation in online crowdsourcing platforms as shown in Figure 1. Specifically, we conjecture that solvers' perceptions of point, feedback and social network elements positively affect their perceived distributive justice, interactional justice and informational justice, which, in turn, positively affect their crowdsourcing participation.

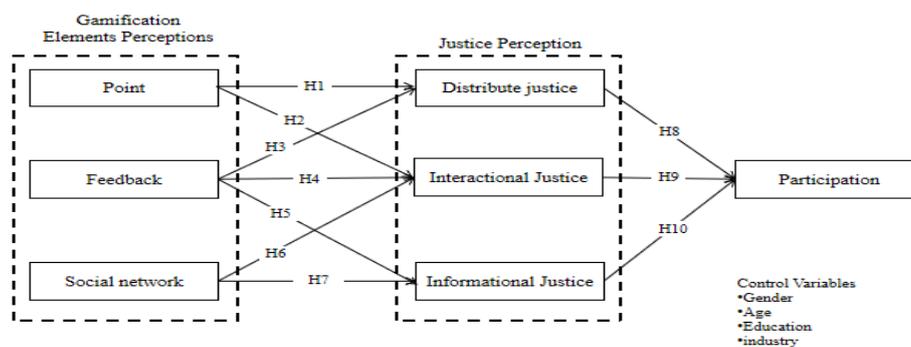


Figure 1: The Research Model

Point

As one of the most studied gamification elements in the literature, point is an achievement-related element. When solvers join crowdsourcing contests and win the bids, they will receive a number of points as virtual reward in addition to the monetary compensation. Based on a preponderance of managerial literature, providing virtual rewards is a significant part of employee compensation plan. Solvers typically devote massive efforts of time and energy to obtain the bids in the online crowdsourcing platform. Rewarding solvers with virtual incentives such as points show that the platform values the efforts of the solvers. Solvers' emotional efforts can be compensated by such virtual incentives. Hence, their perceptions of distributive justice will be reinforced. At the same time, when solvers receive points from the platform, they will feel that the platform treats them with respect and politeness, i.e., with interactional justice, hence being inclined to join in the tasks in the future. In addition, as a kind of incentive to give virtual currency, points are a reward for the solver who wins the task of the crowdsourcing platforms and gets a reward after completion. Information Justice focuses on the disclosure of the task requirements and evaluation information released by the solvers. Hence there is no connection between the former and the latter. Therefore, we speculate that,

H1: Point leads to higher perception of distributive justice by solvers.

H2: Point leads to higher perception of interactional justice by solvers.

Feedback

In addition to points, another achievement-related gamification element is performance feedback. After a crowdsourced task is completed and the winning bid (s) is selected, the crowdsourcing firm will be asked to offer clear and reasonable feedbacks to all the submissions, explaining the reasons why these submissions are/are not accepted. A large proportion of prior research has found that solvers have a normal expectation about receiving explanations for their failed submissions. Offering performance feedbacks fulfill such expectation and can enhance solvers' distributive justice. In the meantime, giving feedbacks also means that the crowdsourcing firm cares about the feeling of independent solvers and puts reasonable efforts to compensate them. Such behaviors will make solvers feel that they are treated with politeness, thereby developing a sense of interactional justice. Apart from that, when the selection criteria of the winning bids is rather ambiguous or subjective, the provision of performance feedbacks can at least make the final decision more "justifiable". Solvers will think that they have received enough information regarding the decision making criteria, hence generating the perception of informational justice. Hence, we expect that,

H3: Feedback leads to higher perception of distributive justice by solvers.

H4: Feedback leads to higher perception of interactional justice by solvers.

H5: Feedback leads to higher perception of informational justice by solvers.

Social Network

As discussed above, social networking features enabling the communication between the crowdsourcing firms and solvers can also enhance solvers' participation intention. When solvers have questions regarding the requirements and progress of the crowdsourcing tasks, they can employ the social networking tools in the platform to communicate with the crowdsourcing firms. Prompt and concise responses provided by crowdsourcing firms through such communication channels can foster solvers' perception of interactional justice. Similarly, when there are channels through which solvers can receive information on the task requirements and progress, they will feel that they possess equal information comparing to their peers, that is, higher perception of informational justice. On the other hand, Distributive Justice is the fairness between the solver's effort and reward in completing the task, that is, whether the reward obtained after completing the task conforms to his inner expectation. The Social Network is a way to enhance the interaction between the Crowdsourcing platforms and the solvers during the task execution process, thus it has no relationship with whether the effort and reward are equal. Therefore, we speculate,

H6: Social network leads to higher perception of interactional justice by solvers.

H7: Social network leads to higher perception of informational justice by solvers.

Distributive, Interactional And Informational Justice Perceptions

Literature on organizational justice has provided much evidence that justice perception has a clear impact on individuals' attitudes and behaviors. Individuals who feel that they are treated unfairly by employers will be disappointed, and such disappointment will foster their efforts to restore justice within the relationship; if not, individuals will decide to terminate the employment relationships (Greenberg, 1993). On the contrary, if individuals perceive that they are fairly treated, they will have more commitment on the employers and be proactive in their work. In the context of crowdsourcing, when solvers perceive that their contributions are fairly rewarded, i.e., distributive justice, they will be more active in task participation. Similarly, when solvers feel that they are treated with courtesy and politeness by the platform and crowdsourcing firms, i.e., interactional

justice, they will be more willing to contribute. Lastly, when solvers believe that they have received equal information as compared to other competitors, i.e., informational justice, they will sustain their participation in the future. Based on the above discussion, we speculate,

H8: Distributive justice perception is positively related to solvers' crowdsourcing participation.

H9: Interactional justice perception is positively related to solvers' crowdsourcing participation.

H10: Informational justice perception is positively related to solvers' crowdsourcing participation.

In order to control for potential bias from the sample selection, we include age, gender, education level and industry background as control variables in the model.

RESEARCH METHODOLOGY

We collect research data from the target population of a well-known Chinese micro-task crowdsourcing platform through online survey. Previous studies suggest that latent variables like the constructs in our theoretical model are best examined by the survey method (Kankanhalli et al., 2015). We must emphasize the fact that the online crowdsourcing platform in this study (i.e., Zhubajie.com) falls into the type of competition-based platform, as the majority of tasks in this platform are sourced by soliciting individuals to compete with one another by the crowdsourcing companies. A crowdsourced task might receive a large number of submissions from solvers. However, the crowdsourcing firms will only choose one or a few qualified submissions. Individual solver could obtain a certain amount of points if his or her submission is selected and financially rewarded. Solvers can utilize the social networking tools (i.e., live chat, in-mail) to communicate with the firms during the bidding process of crowdsourcing. In addition, the crowdsourcing firms can voluntarily give performance feedbacks and evaluations to every single submission for their crowdsourced tasks. In general, tasks crowdsourced in this platform fall under the category of "easy task with high outcome variety". Tasks include translation, Website design, as well as logo design, which require the solvers have a certain amount of creativity and specialized knowledge.

Sample

The method of gathering data in this study is sending invitation via private message to registered solvers of the crowdsourcing platform. The message included an invitation note and a hyperlink to the questionnaire posted in an online survey website (www.wenjuan.com). We acquire a full list of registered solvers from the platform operator and randomly pick out 1,000 individuals from the list. Then we send the invitational private messages to them. Altogether, 326 solvers responded to the survey request, which leads to a response rate of 32.6%. After removing those incomplete and repeated responses, 295 questionnaires in total were selected for data analysis. Table 1 reported the demographic information of the selected samples.

Table 1: Demographics of the Samples

Variable	Item	Frequency	Percentage (%)
Age	< 18	1	0.3
	18-24	96	32.5
	25-35	180	61.0
	36-50	17	5.8
Gender	Male	169	57.3
	Female	126	42.7
Education level	High school and below	19	6.4
	College	90	30.5
	University	169	57.3
	Master PhD	16 1	5.4 0.3
Industry	Education	61	20.7
	IT service	75	25.4
	Manufacturing	40	13.6
	Financial service	9	3.1
	Traditional services	42 68	14.2 23.0
	Others		

Measures

Where applicable, the constructs in the research model were operationalized by adapting existing items from prior literature to ensure validity. Otherwise, new items were developed by referring to the constructs' definitions in previous gamification literature and interviews with subjects. Table 2 shows the survey items for all the constructs.

Table 2: Operationalization of Constructs in the Model

Constructs		Items	Source
Point (PNT)	PNT1	This platform increases my points in correspondence to my behaviors (e.g., submission, winning the bids)	Adapted from (Feng, 2018)
	PNT2	This platform promptly evaluates my behaviors and add up my points	
	PNT3	Points is a critical measure for the competence level of solvers in this platform	
Feedback (FEB)	FEB1	This platform enables the crowdsourcing firms to provide thanks to my submissions	Adapted from (Feng, 2018)
	FEB2	This platform enables the crowdsourcing firms to review my submissions	
	FEB3	This platform allows the crowdsourcing firms to guage the quality of my submission (i.e., good, normal, or bad)	
Social network (SOC)	SOC1	The social system in the crowdsourcing platform allows me to see the activities of other users	Adapted from (Feng, 2018)
	SOC2	The social system in the crowdsourcing platform allows me to communicate with crowdsourcing firms effectively	
	SOC3	The social system of the crowdsourcing platform satisfies my social needs	
	SOC4	The social system of the crowdsourcing platform allows me to communicate with crowdsourcing firms promptly	
Distributive justice (DIS)	DIS1	What I obtain from this platform is fair compared to the efforts I have made	Adapted from (Colquitt, 2001)
	DIS2	What I obtain from this platform is fair compared to the activeness of my response to the crowdsourcing firms' requests	
	DIS3	What I obtain from the platform is fair compared to the speed of response to the crowdsourcing firms' requests	
	DIS4	What I obtain from the platform is fair compared to the time and efforts I devote to completing the tasks	
Interpersonal justice (INT)	INT1	I am treated politely in this platform	Adapted from (Colquitt, 2001)
	INT2	I am treated kindly in this platform	
	INT3	I am treated with respect in this platform	
	INT4	My membership rights are attended and valued in this platform	
Informational justice (INF)	INF1	The crowdsourcing firms can concretely explain the task requirements	Adapted from (Colquitt, 2001)
	INF2	The crowdsourcing firms can communicate with solvers about the task requirements frankly	
	INF3	The crowdsourcing firms can inform me about the details of task requirements promptly	
Solver participation (PAR)	PAR1	I plan to actively join in the crowdsourcing tasks of this platform	Adapted from (Wu & Sukoco, 2010)
	PAR2	I plan to actively join in the tasks of this platform in the future	
	PAR3	I will do my best to participate in tasks in this platform, rather than leaving it	
	PAR4	I will keep a relatively high level of participation in this platform in the future	

To ensure the validity of the newly-developed survey items (i.e., items for point, feedback and social network), we conducted exploratory interviews with 8 crowdsourcing solvers to find out how they recognized and perceived the gamification features when using this crowdsourcing platform. We also launched a pilot test with 40 participants to validate the new items. By referring to Moore and Benbasat (1989), we went through a two-stage Q-sorting process to enhance the content validity, convergent validity and discriminant validity of all the items. All the items were measured with 5-points Likert-scales anchored from “strongly disagree” to “strongly agree” (See Table 2) Items in English were translated into Chinese and given to six information systems researchers who were competent in both languages to translate them back to English. Then we carefully compared the two versions of English items and resolved all the conflicting issues by revising the wording of the items.

RESULTS

In this study, we employed Partial least squares (PLS) to analyze the survey data. PLS-SEM instead of co-variance based SEM is suitable for analyzing the model with latent variables (Wetzels et al., 2009). Bootstrapping was adopted to test the statistical significance of path coefficients according to Wetzels et al. (2009). In the research model, all constructs were modeled as reflective. We used SmartPLS2.0 for data analysis.

The Measurement Model

Convergent validity is tested by measuring the (1) reliability of items, (2) composite reliability of constructs (>0.7), (3) average variance extracted (AVE) (>0.5), and (4) factor analysis results. Reliability of items is guaranteed by checking each item's loading on its related construct (Standardized Factor Loading > 0.7). In the current study, all the item loadings satisfy this criterion (see Table 3). Cronbach's alpha scores (CA) and composite reliability scores (CR) for every construct (see Table 4) are well above 0.70, which is the recommended benchmark for acceptable internal reliability. Table 4 indicate that the AVE score for every construct, ranging from 0.73 to 0.79, far exceeding the suggested value of 0.50. In addition, all the items highly loaded on their own constructs (with the minimum loading of 0.68), thereby showing good convergent validity (see Table 3).

Table 3: Factor Analysis Results

	1	2	3	4	5	6	7
PNT1	0.19	0.16	0.15	0.18	0.23	0.77	0.05
PNT2	0.15	0.07	0.13	0.19	0.22	0.77	0.27
PNT3	0.20	0.16	0.16	0.14	0.16	0.78	0.19
FEB1	0.17	0.12	0.20	0.15	0.78	0.24	0.02
FEB2	0.13	0.14	0.09	0.12	0.83	0.21	0.14
FEB3	0.16	0.12	0.17	0.12	0.77	0.11	0.16
SOC1	0.08	0.15	0.76	0.27	0.08	0.18	0.01
SOC2	0.18	0.28	0.75	0.12	0.16	0.09	0.18
SOC3	0.14	0.14	0.79	0.16	0.15	0.06	0.18
SOC4	0.02	0.24	0.79	0.16	0.14	0.16	0.22
DIS1	0.14	0.79	0.20	0.20	0.10	0.11	0.18
DIS2	0.14	0.76	0.20	0.19	0.07	0.15	0.25
DIS3	0.12	0.81	0.21	0.19	0.14	0.09	0.12
DIS4	0.15	0.76	0.17	0.24	0.14	0.09	0.10
INT1	0.20	0.18	0.22	0.69	0.17	0.21	0.21
INT2	0.16	0.21	0.22	0.72	0.17	0.13	0.21
INT3	0.13	0.26	0.14	0.80	0.09	0.11	0.14
INT4	0.12	0.27	0.24	0.70	0.11	0.17	0.22
INF1	0.14	0.23	0.19	0.24	0.20	0.18	0.76
INF2	0.16	0.24	0.27	0.25	0.08	0.20	0.72
INF3	0.21	0.26	0.19	0.30	0.15	0.21	0.68
PAR1	0.85	0.15	0.06	0.17	0.12	0.12	0.07
PAR2	0.83	0.12	0.16	0.10	0.08	0.15	0.06
PAR3	0.81	0.09	0.06	0.20	0.17	0.04	0.12
PAR4	0.83	0.13	0.09	0.02	0.10	0.21	0.15
Eigenvalue	10.59	2.25	1.70	1.37	1.23	1.06	0.88
% of variance	42.37	8.99	6.81	5.48	4.92	4.24	3.51
Cumulative%	42.37	51.36	58.17	63.65	68.56	72.80	76.32

Table 4: Means, Standard Deviations, Scale Reliabilities, and Inter-Construct Correlations

Variable	Mean	SD	CA	CR	AVE	PAR	DIS	INT	INF	PNT	FEB	SOC
PAR	4.03	0.73	0.90	0.93	0.76	0.87						
DIS	3.69	0.79	0.89	0.92	0.75	0.39	0.87					
INT	3.90	0.64	0.88	0.92	0.73	0.43	0.61	0.85				
INF	3.79	0.72	0.87	0.92	0.79	0.43	0.60	0.66	0.89			
PNT	3.94	0.68	0.85	0.91	0.77	0.44	0.42	0.52	0.56	0.88		
FEB	4.06	0.76	0.84	0.90	0.76	0.39	0.39	0.53	0.45	0.54	0.87	
SOC	3.70	0.74	0.88	0.92	0.73	0.33	0.55	0.57	0.43	0.44	0.43	0.85

Notes: Diagonal elements are the square root of the average variance extracted (AVE)
SD, standard deviation; CA, Cronbach's alpha; CR, composite reliability

We assessed discriminant validity by detecting the item-construct loadings and inter-construct correlations. Table 3 outlines the fact that all items more strongly load on their related constructs than on other constructs. As shown in Table 4, the square

roots of the average variance extracted (AVE) are greater than the inter-construct correlations. Consequently, the constructs demonstrate strong discriminant validity.

Finally, the extent of common method variance (CMV) is assessed by using the marker-variable technique. then we examined correlations between the marker variable and other constructs as the marker variable utilized was fantasizing and theoretically unrelated. Several prior studies (e.g., Ye & Kankanhalli, 2017; Feng *et al.*, 2018) had employed fantasizing as marker variable, and showed positive validity in examining CMV. In this study, the smallest correlation with fantasizing was -0.03 ($p>0.05$), indicating that CMV was not a substantial issue.

Hypothesis Testing

As figure 2 and table 5 shown, demographic variables (i.e., age, gender, education level and industry) were included in the analysis as controls for solver participation. None of the control variables except for gender ($\beta=0.12$, $p<0.01$) were significant, implying that female is more willing to participate in crowdsourcing than male.

It's consistent with our prediction that point shows a significant influence on distributive justice ($\beta=0.292$, $p<0.001$), supporting H1. Point also exhibits a positive influence on interactional justice ($\beta=0.297$, $p<0.001$), supporting H2. As anticipated, the relationship between feedback and distributive justice ($\beta=0.235$, $p<0.001$), interactional justice ($\beta=0.138$, $p<0.001$) and informational justice ($\beta=0.253$, $p<0.001$) are significant respectively, supporting H3, H4 and H5. Social network is also favorable related to both interactional justice ($\beta=0.381$, $p<0.001$) and informational justice ($\beta=0.454$, $p<0.001$), supporting H6 and H7. Consistent with our prediction, distributive justice ($\beta=0.143$, $p<0.001$), interactional justice ($\beta=0.203$, $p<0.001$) and informational justice ($\beta=0.205$, $p<0.001$) all exhibit positive relationship with solvers' participation, supporting H8, H9 as well as H10. Table 5 summarizes the results of the hypothesis tests.

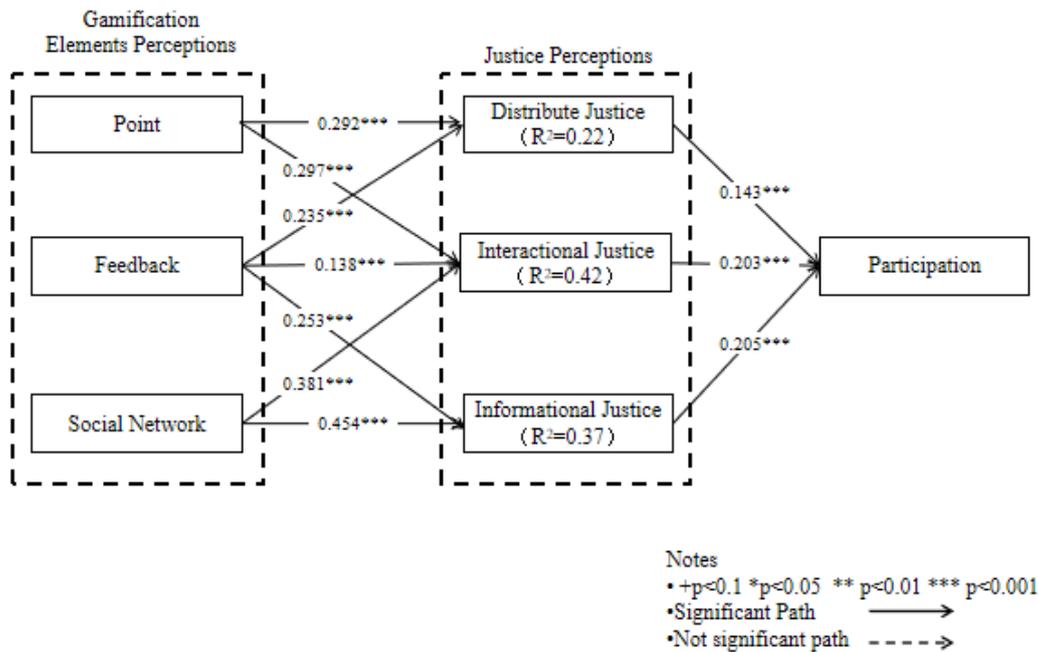


Figure 2: Hypothesis Testing Result

Table 5: Tests of Research Hypotheses

Proposed paths				Path estimate	p-levels	Result
H1	PNT	→	DIS	0.294	<0.001	Support
H2	PNT	→	INT	0.279	<0.001	Support
H3	FEB	→	DIS	0.235	<0.001	Support
H4	FEB	→	INT	0.138	<0.001	Support
H5	FEB	→	INF	0.253	<0.001	Support
H6	SOC	→	INT	0.381	<0.001	Support
H7	SOC	→	INF	0.454	<0.001	Support
H8	DIS	→	PAR	0.143	<0.001	Support
H9	INT	→	PAR	0.203	<0.001	Support
H10	INF	→	PAR	0.205	<0.001	Support

Post-hoc Mediation Analysis

We conduct multiple regression analyses to assess each component of the proposed mediation model. Results are shown in Table 6. First, it was found that point, feedback, and social network are positively related to participation. Second, distributive justice, interactional justice and informational justice were found to be positively related to participation. Third, point is positively related to distributive and interactional justice while feedback is positively related to distributive, interactional and informational justice. Furthermore, social network is positively related to interactional and informational justice.

Table 6: Bootstrapping Test for Indirect Effects (Sample size= 295)

Relations	Coefficient	t-statistics	Bootstrapping β	Confidence Interval (95%)	
				Lower	Upper
Independent Variable-> Mediator (a path)	PNT->DIS	0.490	7.913***		
	PNT->INT	0.490	10.376***		
	FEB->DIS	0.436	7.312***		
	FEB->INT	0.404	8.602***		
	FEB->INF	0.460	8.635***		
	SOC->INT	0.489	11.669***		
	SOC->INF	0.554	11.664***		
Mediator-> Dependent Variable (b path)	DIS->PAR	0.144	2.440*		
	INT-> PAR	0.210	2.704**		
	INF-> PAR	0.243	3.345**		
Independent Variable-> Dependent Variable (c path)	PNT->PAR	0.474	8.412***		
	FEB->PAR	0.402	7.326***		
	SOC->PAR	0.328	6.033***		
Independent Variable-> Dependent Variable (c' path)	PNT->PAR	0.301	4.695***		
	FEB->PAR	0.209	3.503***		
	SOC->PAR	0.068	1.046		
Mediating Effects	PNT->DIS->PAR			0.071	0.020 0.149
	PNT->INT->PAR			0.103	0.028 0.199
	FEB->DIS->PAR			0.045	0.002 0.106
	FEB->INT->PAR			0.070	0.005 0.160
	FEB->INF->PAR			0.079	0.013 0.165
	SOC->INT->PAR			0.126	0.041 0.238
	SOC->INF->PAR			0.135	0.047 0.246

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

As both a-path and b-path were significant, we used the Bootstrapping method with bias-corrected confidence estimates (Preacher & Hayes, 2008) to verify the mediation effects. In the current study, the 95% confidence interval of the indirect effects was obtained with 5000 bootstrap re-samples (Preacher & Hayes, 2008). Results of the mediation effect analysis confirmed the mediating role of distributive justice ($Beta = 0.071$, $CI = 0.020-0.149$) and interactional justice ($Beta = 0.103$, $CI = 0.028-0.199$) in the relation between point and participation; the mediating role of distributive justice ($Beta = 0.045$, $CI = 0.002-0.106$), interactional justice ($Beta = 0.070$, $CI = 0.005-0.160$), and informational justice ($Beta = 0.079$, $CI = 0.013-0.165$) in the relation between feedback and participation; and the mediating role of interactional justice ($Beta = 0.126$, $CI = 0.041-0.238$) and informational justice ($Beta = 0.135$, $CI = 0.047-0.246$) in the relation between social network and participation. In addition, results indicate that the direct effects of point ($Beta = 0.301$, $t = 4.695$; feedback: $Beta = 0.209$, $t = 3.503$) when controlling for the mediators, hence suggesting partial mediations, while the direct effect of social network on participation ($Beta = 0.068$, $t = 1.046$) when controlling for the mediators, thereby suggesting full mediations.

DISCUSSIONS

Nowadays, commercial organizations heavily count on online crowdsourcing platforms to search for effective solutions and creative ideas (Ye & Kankanhalli, 2017). Instigating solvers to participate is an important pre-requisite for the sustainability of these crowdsourcing platforms (Ye & Kankanhalli, 2017). Solvers, like workers, will be more proactive in task solving when they perceive they are fairly treated. Therefore, how to properly design the platform to nurture the fairness perceptions of solvers and motivate their participation is an important but insufficiently studied topic for both researchers and practitioners. Considering this, we seek to investigate how to utilize gamification to generate solvers fairness perception and participation. Empirical results support our hypotheses that the perceptions of three typical gamification elements (i.e., point, feedback and social network) positively affect solvers' participation via their justice perceptions. Specifically, point affects participation through the distributive and interactional justice perceptions, while feedback influences participation through distributive, interactional, and informational justice perceptions. Additionally, social network has an effect on participation via interactional and informational justice perceptions. Taken together, results of this study suggest that gamification elements indirectly

influence solvers' engagement in crowdsourcing tasks through the distributive, interactional, and informational justice perceptions.

Theoretical Contributions

This study has several critical theoretical contributions. First, we develop the gamified crowdsourcing literature (Goh et al., 2017) by theorizing gamification elements into point perception, feedback perception and social network perception, and testing their effects on solvers' justice perceptions and participation. This provides an effective research example for future study on the effects of gamification artifacts.

Second, past empirical literature on gamification has overwhelmed by research on the impacts of gamification elements on solvers' behaviors via motivations (Mekler et al., 2017). Although prior research has inferred that some gamification artifacts may work as non-monetary incentives that supplement the monetary rewards in compensating solvers' efforts and enhancing their fairness perceptions (Mekler et al., 2017), little research has empirically examined the effects of gamification artifacts on solvers' behaviors via their justice perceptions. This study adds up to previous gamification literature by theoretically proposing and empirically justifying the impacts of gamification element perceptions on solvers' participation through their justice perceptions in the crowdsourcing platforms. Results suggest that in crowdsourcing platforms, point, feedback and social network can foster solvers' participation via their distributive, interactional, and informational justice perceptions.

Third, prior crowdsourcing research has been restricted to studying the effects of different justice perceptions on solvers' engagement (Faullant et al., 2017). This study enriches existing crowdsourcing literature (Franke et al., 2013) by stepping further to explore and examine platform designs as antecedents for justice perceptions. Specifically, we conceptualize point, feedback and social network as three typical gamification elements perceptions and bridge them with the distributive, interactional, and informational justice perceptions of the solvers. This inspires our understanding on how the design of crowdsourcing platforms can be tuned to compensate the solvers' efforts and motivate them to participate.

Fourth, this study enriches the literature on organizational justice theory by establishing the theoretical links between organizational justice theory and gamification literature. As a result, we identify three gamification artifacts as the critical sources for solvers' distributive, interactional and informational justice perceptions. This adds to the development of organizational justice theory.

Practical Implications

From a pragmatic perspective, we generate insights to crowdsourcing organizations and platform operators on how to promote solvers' participation. Specifically, this study enlightens practice in three ways. First, it suggests that designing an effective pointstification system can encourage solvers to more actively participate in crowdsourcing. On one hand, this study implies that a fine-tuned pointstification system should be able to motivate solvers' participation in crowdsourcing by reinforcing their distributive justice perception, that is, the evaluation of fairness of economic and socio-emotional outcomes they receive. Crowdsourcing platforms should promote to solvers the notion that earning more points could be regarded by crowdsourcing firms as competent solvers and thus bringing more chances to win the bids. When solvers consider the points as valuable non-monetary incentives, they will believe that their emotional efforts are properly compensated and thus are more willing to sustain their participation. On the other hand, empirical evidences of this study also indicate that rewarding solvers with points immediately after the tasks are completed could make them feel they are politely treated, thereby being more proactive in task participation.

Second, real-time performance feedback by crowdsourcing firms is also important. Crowdsourcing platforms could strive to enhance solvers' distributive, interactional, and informational justice perceptions by urging the crowdsourcing firms to provide immediate and detailed feedbacks for the submissions. Specifically, crowdsourcing firms should be encouraged to reply to as many as the submissions immediately after the task is completed. To realize that, crowdsourcing platforms should devise a function to remind the firms to select bids and offer feedbacks when the bidding period is ended. Additionally, crowdsourcing firms should be encouraged to be constructive when they provide feedbacks. Prompt and constructive feedbacks can reinforce solvers' sense of distributive, interactional and informational justice which, in turn, enhance their crowdsourcing participation.

Third, to strengthen solvers' justice perceptions, multi-channel social networking tools for the effective communication between crowdsourcing firms and solvers are indispensable. To be concrete, crowdsourcing platforms should be able to offer various networking tools (i.e., instant messaging, in-mail) for solvers to communicate with firms before they participate in the tasks. And these social networking tools should be noticeable and easy to use.

Limitations and Future Research Directions

We acknowledge some limitations in this study. First, divergent from prior studies that commonly adopted an experimental approach to examine the effects of gamification artifacts, we examine such effects through a cross-sectional survey, which bears its own merits. Although the experimental method might be more capable in justifying the causal relationships among studied variables, the external validity and generalizability of the findings might be compromised. On contrary, survey could enhance the external validity and generalizability to a certain extent. Apart from that, in this study we operationalized the two

gamification elements as solvers' perceptions, which are latent variables and are best studied with survey method (Kankanhalli et al., 2015).

Second, as different types of crowdsourcing tasks require different amounts of efforts by the solvers, for tasks that are more complicated or large-sized, solvers have to devote a greater amount of time and efforts to complete them (Ye & Kankanhalli, 2017). In this situation, efforts can never be accurately measured and compensated by monetary rewards, solvers may value more on non-monetary incentives and place more emphasis on emotional and interpersonal fairness of the deals. Hence, our findings might be best generalized to large-sized or complicated tasks. We acknowledge that for small-sized or less complicated tasks, solvers might value less on the non-monetary incentives and care more about the immediate monetary rewards. Future research replicating our study should at least take the size and complexity of the crowdsourcing tasks into consideration.

Third, although we carefully select pertinent variables into our model based on theoretical foundations, we cannot exclude a possibility of omitting relevant variables. For example, our model focuses on three main dimensions of justice (distributive, interactional and informational justice). Organizational justice literature suggests that there are another dimensions of justice (i.e., procedural justice). We did not include this dimension in our model because we contemplated that points and feedbacks are not related to processes leading to the selection outcomes, about which these two dimensions of justice concern. However, we acknowledge that some crowdsourcing firms might still incorporate explanations of their selection processes in their performance feedback, which could influence the procedural justice perceptions as well. Future research should also account for this possible link.

This study creates a number of exciting directions for further research. This study confirms the significance of three typical gamification artifacts in enhancing solvers' justice perceptions and participation. However, there is still a range of gamification artifacts used in crowdsourcing platforms of which the working paths remain unknown. We solicit researchers to examine other gamification artifacts (e.g., badges, leaderboard) that might be of the equal importance to solvers' justice perceptions and participation in online crowdsourcing platforms.

CONCLUSIONS

Despite various regulations and promotions applied, solvers' participation keep on shirking in online crowdsourcing platforms. Bearing in mind the importance of solvers' engagement, practitioners have dwelled into the search for various measures to encourage participation. To this end, we offer a theory-driven piece of work to evaluate the importance of gamification elements in assisting practitioners to enhance the prosperity of crowdsourcing platforms via distributive, interactional and informational justice perceptions. Our findings offer clear empirical evidences that the synthesis of gamification literature and organizational justice theory is crucial for a nuance understanding of solvers' crowdsourcing participation. We believe that the theoretical model examined in this study can lay a solid foundation for future research endeavors in this important area.

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Empirical insights into the benefit from implementing smart contracts

(Full Paper)

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ABSTRACT

Smart contracts are highly relevant due to their support for new decentralized business models and processes. We empirically investigate the benefit of implementing smart contracts. Our approach measures the benefit by capturing the impact of implementing smart contracts on processes directly. Thus, our research supersedes previous research that uses deductive approaches for deriving beneficial effects from technical and architectural properties of smart contracts and blockchains. We conduct a systematic approach using the aspects cost, quality, time and flexibility, and their impact on the four process phases interest, agreement, fulfillment, and assessment. Our research enables decision-makers to make decisions on implementing smart contracts more precisely. Furthermore, decision-makers become able to develop more target-oriented initiatives.

Keywords: Smart contracts, benefits, empirical investigation

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INTRODUCTION

Smart Contracts are automated and self-enforcing digital contracts (Cong & He, 2018). They are considered as the most transformative blockchain application due to their decentralized intermediate less architecture (Iansiti & Lakhani, 2017). Currently, many enterprises are implementing smart contracts. For instance, the European insurance company AXA is using smart contracts for their automatic flight compensation insurance “Fizzy”. There are several further use cases like in logistics (Casado-Vara et al., 2018) to avoid intermediaries and speed up activities, etc. Their very first idea was developed by Szabo (1997). In general, smart contracts represent contracts in software (Peck, 2017) that can be executed directly. They built up trust without using intermediaries as third parties (Tapscott & Tapscott, 2016). Furthermore, smart contracts enable the definition of conditions that are tested and trigger actions when fulfilled (Peck, 2017). In this way, participants who have agreed upon conditions store them as smart contracts, and once the conditions are met, actions defined in the smart contract are automatically executed (Ølnes, Ubacht, & Janssen, 2017).

Smart contracts receive huge attention due to their potential to implement ledgers, which are central to many economies, in a completely new way (Casey & Vigna, 2018). Application areas for smart contracts are identified in several research projects, e.g., in supply chain management (Casado-Vara et al., 2018), trade finance (Cong, 2018), food supply chain (Russo, 2018), distributed cloud computation (Cong, 2018), tourism (Calvaresi et al., 2019; Schumacher, 2019), e-commerce (Ramachandiran, 2018), additive manufacturing (e.g., Schmidt et al., 2019) agriculture (Samaniego-Cobo et al., 2018), finance (Rosati & Čuk, 2019), lifecycle of used cars (Zavolokina, Miscione, & Schwabe, 2019) and service systems (Seebacher & Schüritz, 2017). Furthermore, the OpenLaw project (OpenLaw, 2019) intends to automate legal agreements, such as freelance contracts that automatically trigger a payment when the contract’s conditions have been met. Furthermore, Smart contracts are used to enforce license terms and disburse payments (Dutra, Tumasjan, & Welp, 2018). According to current research (e.g., Möhring et al., 2018; Risius & Spohrer, 2017), the benefit of implementing smart contracts is important for research and practice. For instance, Felin and Lakhani (2018) argue that companies have to understand the benefit from blockchains and smart contracts to configure, design, and use them in unique ways and thus providing a strategic advantage. Because it is not possible to outsource strategy definition (Felin & Zenger, 2018), research on the benefit of smart contracts and influencing aspects is essential to firms.

Based on different published research literature reviews (e.g., (Bermeo-Almeida et al., 2018; Casino, Dasaklis, & Patsakis, 2019; Grover, Kar, & Ilavarasan, 2018; Hawlitschek, Notheisen, & Teubner, 2018; Mohanta, Panda, & Jena, 2018; Yli-Huumo et al., 2016)) and on an own extended, systematic literature review according to Webster and Watson (2002) in leading databases such

as AISel, SpringerLink, ScienceDirect, IEEE Xplore regarding related smart contract keywords, there is sparse empirical research about the benefit of implementing smart contracts (e.g. Möhring et al., 2018). Often research focuses on system issues and not on application considerations (Yli-Huumo et al., 2016). Nevertheless, an understanding of the benefit of smart contracts and its influencing aspects are necessary (Felin & Lakhani, 2018) to develop adequate information systems strategies and related research foundations. Therefore, this paper focusses on the benefit of implementing smart contracts and their influencing aspects. The overall research question of our paper is the following: *Which aspects influence the benefit of implementing smart contracts?*

Our contribution is fourfold:

1. We directly and empirically determine the benefit of implementing smart contracts superseding the indirect approaches that deduce the benefit from technological and architectural properties.
2. We use a systematical approach by creating a raster for capturing the benefit using the aspects cost, quality, time and flexibility and the four process phases interest, agreement, fulfillment, and assessment.
3. By creating this raster, we provide an enumeration of alternative for the initiative on smart contracts and support thus the development of methodologies.
4. We increase the quality of decisions of firms on implementing smart contracts.

In the following section, we will first discuss the theoretical background of smart contracts. In the section research design, we describe our research methods and develop four hypotheses that will be tested later on. Subsequently, we describe our research method how we collected data. Finally, we present the results of our research.

THEORETICAL BACKGROUND

Smart contracts had been conceptualized independently from blockchains (Szabo, 1997). However, the capability of blockchain infrastructures to transfer digital assets, such as cryptocurrencies, has led to the two concepts often being considered together. Using blockchains as foundations, smart contracts are defined in formal languages that can be executed by using blockchain technology (Möhring et al., 2018). The basis for the automation in smart contracts are blockchain technologies such as Ethereum (Buterin, 2014) which contain Turing-complete programming languages. By combining this mechanism with a cryptocurrency (Nakamoto, 2008) programs that handle money are created (Narayanan & Clark, 2017). In this way, smart contracts containing such rules enable the transfer of digital assets (Buterin, 2014). To achieve privacy in public blockchains, approaches such as (Kosba et al., 2016) were developed.

It is important to note that early Blockchain Technologies do not have Turing-complete languages. For instance, Bitcoin scripting language has only 256 instructions of whom many are disabled and reserved (Wang et al., 2018). Therefore, using blockchain technologies does not imply the ability to create smart contracts (Mills et al., 2016).

In their core, smart contracts are automatically executed agreements between parties. For instance, a smart contract between a train operator and a client could define the payment for the ride and rules on how to handle reductions if the train is delayed. Smart contracts are written down in a semi-formal language that is executed automatically (Wang et al., 2018). The execution of smart contracts is decentralized (Wang et al., 2018). Each participant uses his virtual machine to execute smart contracts. The virtual machine isolates the execution of smart contracts from specifics of the underlying platform and makes the smart contracts platform agnostic. Therefore, a smart contract can be executed on different hardware and operating system platforms without change. The decentralized execution is the foundation for a distributed consensus model (Wang et al., 2018). The determination what is considered as truth is not done by a central intermediary but by the consensus of the participants.

The agreements in smart contracts can be described by rules of the form event – condition – action (Möhring et al., 2018; Szabo, 2016). In the example of a smart contract for train tickets, an event-condition-action rule could be: if the train arrives (event) and the train is punctual (condition) charge the full fare to the client's credit card (action). If a certain event arises and the defined condition is met, an action is executed. Events may be internal or external (Cong & He, 2018). Internal events originate from within the virtual machine, e.g., from the execution of the same or other contracts. External events originate from the outside of the virtual machine. To prevent fraud external, events a cryptographically signed that means a signature makes it possible to discern true from false events. Conditions are used to filter and differentiate the reaction to events by triggering an action only on the fulfillment of the condition (Cong, 2018; Szabo, 2016). Furthermore, conditions may be used to differentiate the reaction to events by choosing one or several actions depending on the fulfillment of one or several conditions. The actions specified in the event condition action rules specify either the change of variable or the transfer of digital assets.

A challenge for smart contracts is trustworthy sources for events and data. They are called "oracles" (Cong & He, 2018). Without "oracles" fraudulent events and data could be used to gain financial advantages. For instance, by providing an incorrect arrival time of a train, a compensation payment could be fraudulently triggered.

Contrary to existing research on the benefit from smart contracts, which uses a deductive approach, we measure benefit from cost, quality, time, and flexibility aspects and use a process-oriented view. We apply an empirical method by interrogating experts. Based on technical and architectural properties, potential impact aspects on the benefit of smart contracts are identified but not

quantified in the research from Wang et al. (2018), Ølnes et al.(2017), Alexopoulos et al. (2019), Karamitsos et al. (2018), and others.

The identity of contract specification and implementation denotes that the contract defined using a semi-formal language can be directly executed on a multitude of platforms. The contract is represented as program code (Tapscott & Tapscott, 2016). Thus, there is no effort necessary to transform a natural language specification into software. The direct execution also avoids errors during this transformation.

Decentralized consensus has been identified as the central mechanism of smart contracts (Cong & He, 2018). Also, Abadi and Brunnenmeier (2018) identified decentralization as technical benefit of smart contracts. Smart contracts provide a means for reaching consensus and coordination using a decentralized, peer-to-peer oriented approach (Atzori, 2017). The decentralized consensus increases resiliency and reduces the rent extracted by third parties (Cong & He, 2018). Decentralization avoids single points of failure and reduces cost by omitting centralized third parties (Cong, 2018). Casado-Varo et al. (2018) use smart contracts to avoid intermediaries and fasten up logistics. Already by Möhring et al. (2018) automation has been identified as characteristic of smart contracts. Automation means that smart contracts execute tasks, decisions, and the sensing of events without human intervention. After the execution of one task, the following one is executed automatically. Decisions are made without delays by the involvement of human decision makers. Upon events, the smart contract can react automatically.

Another technical benefit is correctness. Smart Contracts take the idea of blockchains to put data in a secure ledger and extend it into computation (Narayanan & Clark, 2017). In this way, a consensus protocol for the correct execution of a publicly specified program is defined (Narayanan & Clark, 2017). They are based on tamper-proof consensus on contingent outcomes (Cong & He, 2018). Correctness as technical benefit is confirmed by Abadi and Brunnenmeier (2018). Correctness embraces both static and dynamic aspects. The static correctness of contracts and their execution history means that contract and the logs documenting their execution cannot be altered. The dynamic correctness means that only actions are executed, which are in conformance with the rules defined in the contracts. Smart contracts assure that the overall system moves from one correct state to another only.

The transparency of smart contracts means that both the contracts and the transaction history are transparent to all stakeholders and auditable (Atzori, 2017; Tapscott & Tapscott, 2016). By this mean a single source of truth is created. Huge documentation as with previous approaches is avoided (Möhring et al., 2018). Smart contracts and their execution are resilient (Gervais et al., 2016). Due to replication and redundancy, the failure of single participant nodes does not hamper the execution of smart contracts. This is achieved by using a distributed architecture in combination with a scale-out approach (Ferdman et al., 2012). The distributed system created is more resilient and scales better (Ferdman et al., 2012). In the same way, the loss of single nodes containing contract definitions and execution logs do not endanger the availability.

Some isolated pieces of research also address the direct impact of implementing smart contracts. For instance, efficiency was identified as important advantage of smart contracts by Cong (2018). Cost and reliability were identified by Ølnes et al.(2017). Alexopoulos et al. (2019) investigated quality and flexibility. However, none of the former studies used a quantitative approach. Instead, qualitative investigations were used to derive the benefit. Therefore, a lack of empirical evidence on the benefit of smart contracts exists. It has been confirmed by Fan et al. (2018). The further development of smart contracts is documented by Narayanan and Clark (2017).

Research Design

In general, the benefit of implementing smart contracts can be defined as the “individual perceived capability of using and implementing smart contracts” (Möhring et al., 2018; Schmidt et al., 2015). For the investigation of the benefit of smart contracts and its influencing aspects, we focused on knowledge resulting from previously published research (Webster & Watson, 2002). In general, smart contracts are used to support cross-organizational business processes (Grefen et al., 2000). Cost, quality, time and flexibility as important aspects of business processes. To take a deeper look into these aspects of smart contracts, we must differentiate the phases of a (smart) contract process. Therefore, we used the research of the phases of business processes of Goldkuhl (1998). Hence, we differentiate four phases: The interest phase, the parties exchange information on their offerings, the agreement phase, and the parties commit to a contract. The obligation of the contract such as delivery and payment are part of the fulfillment phase. In the assessment phase, the fulfillment of the agreement by the other parties is evaluated, and potential claims for compensations are defined.

Using this two-dimensional raster (Figure 1), the benefit of smart contracts can be associated in the first dimension with an aspect such as cost, quality, time and flexibility and with one or several phases in the second dimension such as interest, agreement, fulfillment, and assessment. Cost, quality and time are conflicting goals for optimizations according to Gardiner (Gardiner & Stewart, 2000). It has been extended by flexibility as fourth conflicting goal (Dumas et al., 2018).

	Interest	Agreement	Fulfillment	Assessment
Cost				
Quality				
Time				
Flexibility				

Figure 1: Two-dimensional raster for capturing the benefit from implementing smart contracts

The groundwork for capturing the cost benefits of smart contracts can be found in the transaction cost economics (Coase, 1937) and transaction cost theory (Williamson, 1979). Transaction cost is defined as the additional cost when using market-based instead of hierarchical coordination (Malone, Yates, & Benjamin, 1987). Transaction cost influences make-or-buy decisions (Walker & Weber, 1984) in the way that reducing transactions cost facilitates the use of external resources and thus increases the options for resource supply (Poppo & Zenger, 1998). In this way, new types of economic organization and governance are enabled. We assume that cost during the process of a contract positively influence the benefit of implementing smart contracts. Therefore, we formulate the hypothesis H1:

H1: Cost aspects positively influence the benefit resulting from implementing smart contracts.

In general, quality is the conformity of defined and real result of a process (Dumas et al., 2018). This includes both functional as non-functional properties such as the fulfillment of Service-Level-Agreements (Grigori et al., 2001). A process good in quality produces results by optimizing one or more quality features (Krogstie, 2016). High process quality is important to avoid negative impacts on the reputation and to avoid lost revenue, cost for damages, and contractual penalties (Dumas et al., 2018). Also, the additional processes necessary to compensate for a lack of quality can be very resource intensive. First indications for the positive impact of smart contracts and blockchains on quality, in particular, supply chain quality is given by Chen et al. (2017). Therefore, we define our hypothesis H2:

H2: Quality aspects positively influence the benefit resulting from implementing smart contracts.

The impact of time aspect on the benefit of smart contracts has been identified by Mohanta et al. (2018). Time impacts the benefit of smart contracts both on the schema and the instance level (Dumas et al., 2018). On the schema-level reductions in the time needed for adapting contracts helps to adapt it more quickly to changed requirements. Especially, the conditions of the contract can be adapted more closely to the actual market conditions. Furthermore, the reduction of time needed to run through the phases of the process instance is beneficial according to Dumas et al. (2018), Reijers and Mansar (2005) and Kohlbacher (2010). Furthermore, less time is needed; the reaction time to external events is shorter. Based on this, we suggest that improved quality of the contracting processes influence the benefit of implementing a smart contract positively. Therefore, we defined hypothesis H3:

H3: Time aspects positively influence the benefit resulting from implementing smart contracts.

Flexibility may embrace different perspectives such as the definition of task and rules, the assignment of task and data structures (Regev, Soffer, & Schmidt, 2006). It is necessary to cope with situations that cannot be prescribed, and business changes (Nurcan, 2008). Flexibility includes both parametrization and configuration (Dumas et al., 2018). Flexibility is impacting the benefit of smart contracts, according to Alexopoulos et al. (2019) and Korpela et al. (2017). Therefore, we assume the following influence in hypothesis H4:

H4: Flexibility aspects positively influence the benefit resulting from implementing smart contracts.

The conceptual research model is summarized in the following Figure:

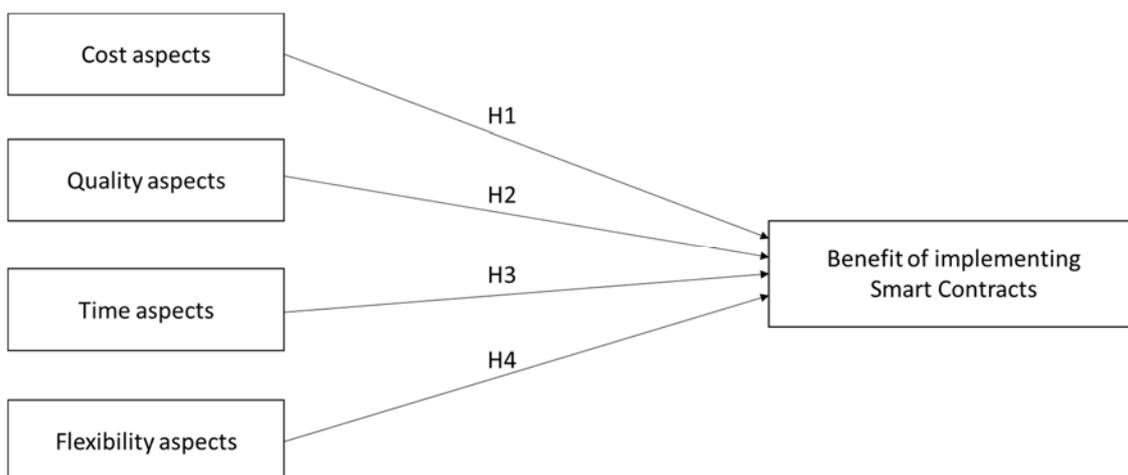


Figure 2: Research Model

Research Method and Data Collection

For the implementation of our research design, we have chosen a quantitative research approach regarding the recommendations of the current scientific literature (Recker, 2013). We used a web-based expert online survey for collecting the needed empirical data. The questionnaire was implemented via the web-based tool LimeSurvey. Questions discovering our research model were designed using a five-point Likert scale (e.g., statement questions from 1: “totally disagree” to 5: “totally agree”). The questions/items for each aspect are resulting from the identified related literature (e.g., Dumas et al., 2018; Möhring et al., 2018). The individual aspects of our conceptual research model were evaluated through different items. For instance, we asked questions (items) on 1) the overall benefit of implementing smart contracts, 2) the individual benefit of implementing smart contracts in the enterprise of the expert, 3) the effort related to the benefit of implementing, and 4) the usefulness/ease of use of implementing smart contracts. For the quality, cost, time and flexibility aspect items we asked questions related to the aspects of smart contracts of the related important process phases of a contract based on Winograd and Flores (1986) and Goldkuhl (1998). Furthermore, questions regarding the working experience and knowledge, impact of smart contracts to different areas, enterprise background of the experts as well as, e.g. gender were asked.

To reach the experts in our research field, we have contacted formal and informal the experts (e.g., via email, business social networks, contacts of the chamber of commerce, etc.). For ensuring a high quality of research, we have implemented different check-questions regarding the knowledge of our experts in the related field (e.g., knowledge and working experience in the field of smart contracts). Furthermore, in terms of the quality of our study, we run a pre-test of our questionnaire for improving it. We collected a data sample of $n=108$ experts in the time from October until December 2018 in German-speaking countries (Germany, Austria, Switzerland). After data cleaning (e.g., through missing data and check questions), we collected a final sample of $n=71$. The data formatting and cleaning process were supported by technical tools like Microsoft Excel based on .csv and .xls files. Our experts currently working in the field of smart contracts and planning or implementing them. The experts have approx. ten years of working experience in related industry sectors and working for enterprises with 31,334 employees on average coming from sectors like information and communication technology, finance, manufacturing, etc. Furthermore, $n=7$ of our experts are female, and $n=64$ are male. In general, for approx. 79% of our experts implementing smart contracts are very beneficial. Furthermore, the majority (approx. 95%) of our experts think that their current business models will be influenced by smart contracts. Business processes implementing smart contracts will be changed in the future based on the opinion of most of our experts (approx. 95%).

A structural equation modeling (SEM) approach (Hooper, Coughlan, & Mullen, 2008; Wong, 2013) was used to analyze our empirical data with our causal model. In general, the approach consists of two models (Wong 2013): the structural model (developed in the research design section of the paper, see Figure 2) and the measurement model (described by items above and criteria's in the results section). We used a PLS approach with Smart PLS regarding the literature and our sample size as well as less empirical research in this area (Ringle, Wende, & Becker, 2015; Wong, 2013). The approach is based on the calculation of least squared regression on sumscores. We run the Java-based smart PLS software version 3.2 with the recommendations of the literature (Ringle et al., 2015; Wong, 2013). Furthermore, the level of significance was calculated via the method of bootstrapping based on the related recommendations of the literature (Wong 2013) and should be below $p<0.05$ to reach a significant level. All needed quality metrics were calculated to ensure a high quality of research. For instance, the coefficient of the determination (R^2), composite reliability, etc. are in a satisfying range (see the results section as well as Table 1). Therefore, our model ensures a high reliability according to the recommendations of the scientific literature. The used method is common in information systems research as well as recommended (e.g., Siponen & Vance, 2010). In the following, we present our empirical insights evaluating our research model.

RESULT

After analyzing our causal research model with our collected empirical data, we got the following results (Figure 3). Regarding the quality of our model, the coefficient of the determination (R^2) is with the value of $0.617 > 0.19$ satisfying according to the recommendations of the literature related to Chin (1998). The other metrics of our model are shown in table 1 and are also in a satisfying, reliable range (e.g., composite reliability > 0.7 (Henseler et al., 2014)).

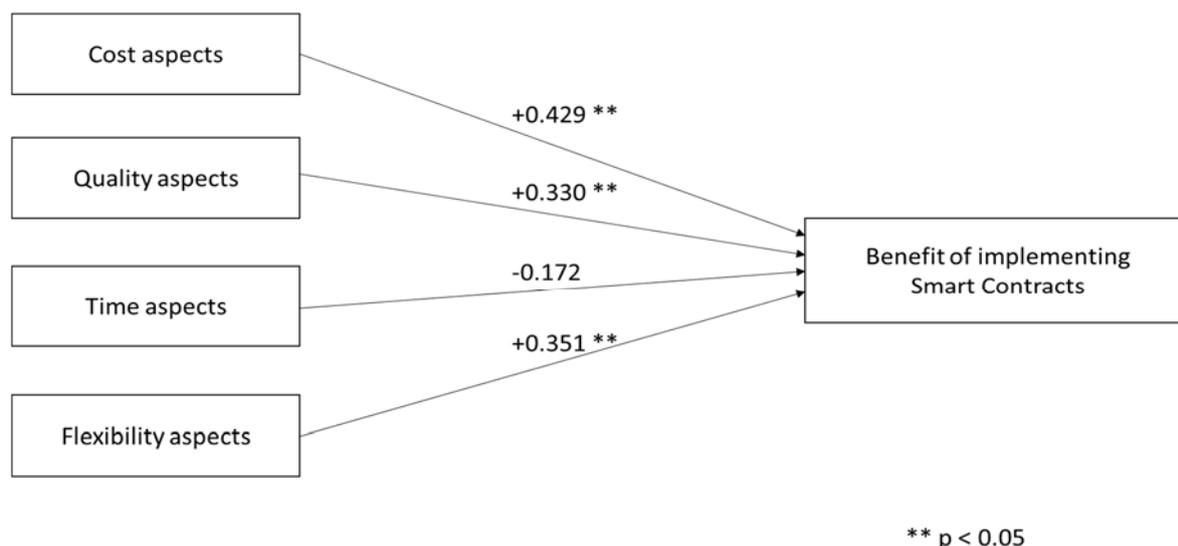


Figure 3: Results

Cost aspects

Regarding the analysis of our first hypothesis, we can support our hypothesis, because of a significant positive path coefficient (+0.429; $p < 0.05$). Therefore, cost aspects positively influence the benefit of implementing smart contracts. The reduction of cost can be explained by several factors. First, smart contracts do not involve intermediaries that demand fees, etc. for their services (Alexopoulos et al., 2019; Beck et al., 2017; Risius & Spohrer, 2017). Second smart contracts provide a high degree of automation during all phases of the process (Casino et al., 2019; Notheisen, Cholewa, & Shanmugam, 2017; Seebacher & Schüritz, 2017). Furthermore, cost is reduced by the identity of the smart contracts with its implementation (Carter & Ubacht, 2018; Karamitsos et al., 2018). Contrary to conventional contracts, now, software development is necessary to implement a smart contract. Furthermore, cost impacts the benefit from smart contracts differently in the four phases. In the interest, phase is lower than in the agreement phase, where costly intermediaries can be avoided. During the fulfillment phase, the cost for tracking and tracing the process execution can be reduced. Using smart contracts, the assessment phase can be reduced significantly, because automatic mechanisms in smart contracts and the transparency avoid situations needing disputes.

SEM-Path	Path Coefficient	Signifi-cances	Factor/ Aspect	Cronbach's α of the factor	Composite reliability
Cost aspects → Benefit of implementing a smart contract	+0.429	0.001	Cost aspects	0.7	0.8
Quality aspects → Benefit of implementing a smart contract	+0.330	0.007	Quality aspects	0.8	0.9
Time aspects → Benefit of implementing a smart contract	-0.172	0.239	Time aspects	0.7	0.8
Flexibility aspects → Benefit of implementing a smart contract	+0.351	0.007	Flexibility aspects	0.9	0.9
-	-	-	Benefit of implementing a smart contract	0.8	0.8

Table 1: Rounded metrics of the results of the analysis of the structural equation model

Quality aspects

The positive influence of quality to the benefit of implementing smart contracts can also be supported by our analysis. Consequently, hypothesis H2 can be confirmed based on a significant, positive path coefficient (+0.330; $p < 0.05$). Quality is increased

because contracts and software technical implementation is one and that all contractual partners use the same implementation; thus the identity of contract and implementation (Carter & Ubacht, 2018; Karamitsos et al., 2018). Previous approaches had to create software to implement the contract. Often several implementations were necessary because of different platforms at the contractual partners. Smart contracts, however, only use one contract that is the implementation for all partners and thus avoid inconsistent implementation. Also, automation contributes to quality by avoiding human interventions with a high error rate (Casino et al., 2019; Wang et al., 2018). The high transparency of smart contracts also contributes to quality (Batubara, Ubacht, & Janssen, 2018; Karamitsos et al., 2018), because it creates a single source of truth (Friedlmaier, Tumasjan, & Welp, 2017; Zavolokina et al., 2019) and thus avoids inconsistent interpretations. Quality is also improved by the resiliency of smart contracts (Atzori, 2017; Gervais et al., 2016). Furthermore, Mohanta et al. (2018) argue, that also the higher accuracy of smart contracts can be used as an explanation. Furthermore, automation increases the quality in the contract fulfillment phase primarily.

Time aspects

Furthermore, time aspects are interesting for our experts. However, on the base of our analysis, we cannot confirm our hypothesis 3, because of a missing significance ($p=0.239>0.05$). In general, time aspects are necessary to evaluate and improve contract related processes. Research suggests that the execution time is reduced by automation implementation (Carter & Ubacht, 2018; Karamitsos et al., 2018). Furthermore, another factor inside can be the speed and real-time updates (Mohanta et al., 2018). This includes the proceeding of the process and the reaction to external events. However, regarding our non-significant data, the majority of our experts might be not confident about timing aspects. Therefore, more future research and a deeper look into cost aspects are needed.

Flexibility aspects

Finally, flexibility aspects are very important for our experts regarding our data analysis. We can significantly ($+0.351$; $p<0.05$) support hypothesis 4. Therefore, the flexibility of smart contracts positively influences the benefit coming from implementing smart contracts. This can be explained by multiple factors. Flexibility is enabled by the ability of smart contracts to quickly implement changes due to the identity of smart contract and its implementation (Carter & Ubacht, 2018; Karamitsos et al., 2018). Thus, changes in the interest and agreement phase can be implemented directly and without running through multiple steps of an implementation process. Also, the high degree of automation in smart contracts contributes to their flexibility especially in the fulfillment and assessment phase because rules to cope with different situations can be quickly selected and executed process (Casino et al., 2019; Notheisen et al., 2017; Seebacher & Schüritz, 2017). In the following, a conclusion, as well as discussion, is given based on our research results.

CONCLUSION AND DISCUSSION

Smart contracts are important for information systems research and practice, as well (Möhring et al., 2018; Risius & Spohrer, 2017). Smart contracts will transform structures, processes, and intermediaries in firms using them (Iansiti & Lakhani, 2017). To make markets thrive, their participants have to be able to efficiently verify and audit transaction attributes (Catalini & Gans, 2016). In general, contracts are essential for firms: they are used to procure material, hire personnel, and sell goods. Therefore, technology is of huge importance that can automate the creation, definition, making, and execution of contracts. In the past, there was a lack of research about the benefit of implementing smart contracts and its influencing factors. We respond with our research to the need of more scientific work driven by past research (Möhring et al., 2018; Risius & Spohrer, 2017). Our research develops a related research model, evaluate the model through a quantitative expert study and show first empirical results as well as discussions. We found that cost, quality and flexibility aspects influence significantly the benefit resulting from implementing smart contracts.

There are several implications for research and practice based on our results. Our research extends the scientific knowledge base about the benefit of implementing smart contracts and its influencing factors. We showed empirically how strong these factors are. We extend previous research in different ways. Our research supports and extends the strategic decision making on smart contracts and decision making, identified as an important theme of research by, e.g., Felin and Lakhani (2018) and Carson et al. (2018). Furthermore, we extend the practical, driven research view of smart contracts of, e.g., Möhring et al. (2018) to more focus on the side of benefits of implementing smart contracts and its influencing factors. Also, practice can benefit from our research. Related managers can use our results to evaluate the implementation of smart contracts in their business. Different practical use cases can be compared based on different influencing factors. Furthermore, our research shows more insights into this relatively new topic for business to clarify important aspects and support decisions. Enterprise and organizations can directly determine the impact of smart contracts on their processes.

Limitations can be found in the research method and sample size. Furthermore, we selected only experts from German-speaking countries (Germany, Austria, Switzerland). However, our research approach is commonly used in information systems research (e.g. Ortbach et al., 2013; Schmidt et al., 2015) and shows interesting scientific findings. Future research can be used to cover these limitations and extend the knowledge base. For instance, comparative studies with experts from different major countries like, e.g., China and North America can be used for comparison, evaluation as well as the extension of our research. We could not address all the possible factors in our study. Therefore, there is a good opportunity to enlarge the number of factors to explain the benefit of implementing smart contracts. Furthermore, qualitative studies to evaluate implementation projects are also a good starting point for future research.

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Evaluating IT alignment and performance in SMEs using multivariate regression analysis

(Full paper)

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ABSTRACT

New competitive challenges have forced Small-Medium Enterprises (SMEs) to re-examine their internal environment in order to improve competitive advantage. IT investments can improve firm performance in a way that it would be in “alignment” with business strategy. The purpose of this paper is to analyze the contemporary impact of IT and business strategy on business performance, incorporating all these constructs into a model that is tested using Multivariate Regression Analysis. Data were collected from IS executives in 160 Greek SMEs. The results of this survey show that Strategy conception and formulation have a significant impact on business performance.

Keywords: Strategic Information Systems Planning, Alignment, IT strategy, Business strategy, Performance, SMEs.

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INTRODUCTION

As businesses are obliged to deal with the environmental uncertainty and complexity, managers have to develop Information Systems (IS) that support business strategy, and accommodate decision making in order to increase competitive advantage (Merali *et al.*, 2012; Queiroz, 2017; Zubovic *et al.*, 2014). As new competitive challenges and requirements have been raised due to the growth of international business, firms are forced to re-examine their internal business environment in order to increase their performance and achieve a competitive advantage. However, IS could be a source of sustainable competitive advantage only if the IS strategy will be aligned with business strategy. Thus, many companies have spent their resources in order to increase their competitive advantage by looking at their internal processes (Chatzoglou *et al.*, 2011; Johnson & Lederer, 2013; Wolf & Floyd, 2017). This is a crucial challenge for businesses and especially for Small-Medium Enterprises (SMEs).

As the current financial crisis has negatively affected plenty of activities of SMEs, they have already acted in a new complex financial environment where uncertainty increases and the market characteristics completely change. Except for difficulties in their financial aspect, their relative lack of technological, managerial and human capabilities may limit their ability to bowl over the financial crisis (Bourletidis & Triantafyllopoulos, 2014; Giannacourou *et al.*, 2015; Kitsios & Kamariotou, 2017). Moreover, the lack of strategic planning negatively influences this difficulty. Formal processes in SMEs that are related with strategic management and information handling help managers to focus on strategies, structures and processes that aim to enhance firm performance. Thus, IT investment has been a crucial issue for managers because IT influences business performance and help executives to align business strategy and organizational performance. In complex environments, businesses could develop formal processes using standardized rules and procedures which enhance the minimization of environmental uncertainty and manage economic consistency (Drechsler & Weißschädel, 2018; Queiroz, 2017; Ullah & Lai, 2013).

Traditionally, the concept of alignment is conceptualized as the extent of fit between IT and business strategy. Several studies found that there is a positive relationship between alignment and performance (Chatzoglou *et al.*, 2011; Queiroz, 2017; Street *et al.*, 2017). With regard to the relationship between alignment and performance researchers argue that SMEs can use different paths in order to achieve a great extent of alignment according to their capabilities and market position. Thus, a more extensive planning would be more effective because it would support planners understand the impact of the environment and better respond to it. If managers invest too many efforts, many conflicts among team members can be raised as well as the process could be delayed. On the other hand, if managers avoid investing too much time into the process, IS plans could be inefficient so IS goals could not be achieved. Consequently, the assessment of the process is significant because managers can reduce these unsatisfactory results (Kappelman *et al.*, 2019). Unfortunately, IS strategy has been studied as a homogenous topic and limited studies delving into comparing the state of relevance across planning or alignment. Previous researchers have examined the relationship between the strategic planning of IS and the success as well as the obstacles that managers face in large companies (Mirchandani & Lederer, 2014; Newkirk & Lederer, 2006; Newkirk *et al.*, 2003).

Despite the fact that studies on strategic alignment in SMEs investigate some of the same topics as research conducted with larger firms, SMEs' uniqueness warrant investigation on their own. Nevertheless, SMEs represent a distinct grouping of firms where firm size and resource constraints have a noticeable influence on alignment factors and outcomes (Kitsios & Kamariotou, 2019a; b; c; Street *et al.*, 2017). Management literature has shown that advances in IT are leading to increasing levels of

adoption and use of IT in SMEs and are pushing technology further and further into SMEs processes and operations. Because many competitors and suppliers now use IT in their operations, executives (and researchers) need to be aware of how the alignment of business and IT strategies impacts firms (Spinelli *et al.*, 2013; Street *et al.*, 2017). Therefore, the purpose of this paper is to analyze the contemporary impact of IT and business strategy on business performance, incorporating all these constructs into a model that is tested using Multivariate Regression Analysis.

The structure of this paper is as following: after a brief introduction to this field, the next section includes the theoretical background regarding the SISP process and business performance. Section 3 describes the methodology, while Section 4 shows the results of the survey. Finally, Section 5 discusses the results and concludes the paper.

THEORETICAL BACKGROUND

As the current financial crisis has negatively affected plenty of activities of the family businesses, they have already acted in a new complex financial environment where uncertainty increases and the market characteristics completely change. Financial barriers, as well as the lack of technological, managerial and human capabilities may limit their ability to deal with the financial crisis (Bourletidis *et al.*, 2014; Vassiliadis & Vassiliadis, 2014). Moreover, the lack of strategic planning negatively influences this difficulty. Formal processes in SMEs that are related with strategic management and information handling help managers to focus on strategies, structures and processes that aim to enhance firm performance. In complex environments, businesses should develop formal processes using standardized rules and procedures which enhance the minimization of environmental uncertainty and manage economic consistency. Formalization supports the development of frameworks that require both communication among the individuals and sharing of new information. Moreover, it encourages the transformation of new ideas into real plans using flexible structures. In this way, the level of innovation in the organization is increased (Giannacourou *et al.*, 2015; Siakas *et al.*, 2014).

There is a lack of strategic planning and formal processes in SMEs and they use IS ineffectively because they cannot align business and IT strategy. Researches have thoroughly implemented in this research area so that managers could understand the relationship between strategic alignment and the business value of using IT. The results of these investigations show that researchers have determined the following types of alignment between business and IS strategy and structure. The first type presents business alignment between business strategy and structure. The second type concerns IS alignment and discusses issues such as alignment between IS strategy and structure. Finally, the third type is a cross-dimension alignment which involves either alignment between business structure and IS strategy or business strategy and IS structure. Researchers claim that the alignment between organizational perspectives such as strategy, structure, management processes, individual roles and skills with technology can help to increase value in businesses, IS effectiveness and business performance (Suh *et al.*, 2013).

The accomplishment of a high degree alignment between IT and organizational objectives has been mentioned as one of the important issues for IS managers (Reich & Benbasat, 2000). In this view both the organization and IT are consolidated, developing services with the support of IT so that businesses could effectively achieve their goals. Strategic IT alignment is unique for each business because it includes business and IT knowledge that are unique resources for each business in order to help business to achieve its objectives, (Kearns & Lederer, 2003; Kitsios & Kamariotou, 2016; Mithas *et al.*, 2011).

Researchers widely argue that the process of alignment is important for businesses for many reasons. First of all, alignment helps businesses to effectively identify the role of IT which efficiently helps the business to achieve its objectives. Second, another benefit is that alignment encourages businesses to improve both their business scope and their infrastructure by meliorating the relationship between business aspects and IT. Researchers claim that the present alignment models are mostly business-driven rather than IT-driven. As a result, researchers should mostly focus on IT in order to determine the most suitable way in which technology can support the organization. Businesses require to know as well as to make their business strategy clear, so the use of IT can support this effort (Ullah & Lai, 2013).

Although the contribution of alignment methodologies has been mentioned, the following challenges incommode many businesses to align IT with business strategy. First, many decisions about IT are made by business executives who are not aware about IT. This obstacle leads to the organization being misaligned. Another challenge concerns IT executives who are not aware about the business objectives and often cannot realize the needs of business decisions. Finally, business and IT executives are conflicted and they do not trust each other. This influences negatively their relationship and consequently the business competence (Peppard & Ward, 2004; Piccoli & Ives, 2005; Rathman *et al.*, 2004; Ullah & Lai, 2013).

The findings of surveys which study the influence of Strategic Information Systems Planning (SISP) phases on success conclude that IS executives focused their efforts on the Strategic Conception phase. Although planners concentrate their efforts on this phase, they cannot determine the suitable alternative strategies. As a result, their efforts do not positively influence SISP success. So, they cannot achieve their objectives. The most common problems which have been affected the SISP process are the lack of involvement and the failure to apply strategic IS plans. Executives cannot be committed to the plan, consequently the members of the team have difficulties to implement the IS strategy. Moreover, results show that executives understand that the Implementation phase is difficult and significant, so they concentrate on this phase (Lederer & Sethi, 1991; Newkirk & Lederer, 2006; Newkirk *et al.*, 2003; Premkumar & King, 1994; 1991; Zubovic *et al.*, 2014).

Findings from previous surveys indicate that many managers put too much efforts to SISP process while others too little. When managers invest too much efforts, the process could be confused, delayed or its implementation is prevented. When managers avoid investing too much time to the process, the implemented plans could be inefficient so the objectives could not be achieved. Consequently, the assessment of the process is significant because managers can reduce these unsatisfactory results. Findings conclude that managers concentrate more on Strategy Conception and Strategy Implementation and they do not invest time on Strategic Awareness and Situation Analysis and as a result the implemented plans are ineffective and unsuccessful and they do not meet the objectives (Brown, 2010; Newkirk & Lederer, 2006; Newkirk *et al.*, 2003). Moreover, when managers concentrate on the implementation of the process, they may achieve shorter SISP horizons but the strategic goals cannot be met. Executives do not focus on what strategic objectives really concern and how they can increase value to the business because they invest time on the horizon of the project and on minimizing its cost due to limited IT budget (Brown, 2010). Table 1 presents the phases of SISP process and Table 2 the dimensions of SISP success.

Table 1: SISP phases and activities

Phases	Activities	References
Strategic Awareness	Determining key planning issues (SAw1) Determining planning objectives (SAw2) Organizing the planning team (SAw3) Obtaining top management commitment (SAw4)	(Brown, 2004; Maharaj & Brown, 2015; Mentzas, 1997; Mirchandani & Lederer, 2014; Newkirk & Lederer, 2006; Newkirk <i>et al.</i> , 2008; 2003)
Situation Analysis	Analyzing current business systems (SA1) Analyzing current organizational systems (SA2) Analyzing current information systems (SA3) Analyzing the current external business environment (SA4) Analyzing the current external IT environment (SA5)	
Strategy Conception	Identifying major IT objectives (SC1) Identifying opportunities for improvement (SC2) Evaluating opportunities for improvement (SC3) Identifying high level IT strategies (SC4)	
Strategy Formulation	Identifying new business processes (SF1) Identifying new IT architectures (SF2) Identifying specific new projects (SF3) Identifying priorities for new projects (SF4)	
Strategy Implementation Planning	Defining change management approaches (SIP1) Defining action plans (SIP2) Evaluating action plans (SIP3) Defining follow-up and control procedures (SIP4)	

Table 2: SISP success dimensions

Dimensions	Items	References
Alignment	Maintaining a mutual understanding with top management on the role of IS in supporting strategy (AL1) Understanding the strategic priorities of top management (AL2) Identifying IT-related opportunities to support the strategic direction of the firm (AL3) Aligning IS strategies with the strategic plan of the organization (AL4) Adapting the goals/objectives of IS to changing goals/objectives of the organization (AL5) Educating top management on the importance of IT (AL6) Adapting technology to strategic change (AL7) Assessing the strategic importance of emerging technologies (AL8)	(Newkirk & Lederer, 2006; Newkirk <i>et al.</i> , 2003)

Analysis	Identifying opportunities for internal improvement in business processes through IT (AN1) Maintaining an understanding of changing organizational processes and procedures (AN2) Generating new ideas to reengineer business processes through IT (AN3) Understanding the information needs through subunits (AN4) Understanding the dispersion of data, applications, and other technologies throughout the firm (AN5) Development of a “blueprint” which structures organizational processes (AN6) Improved understanding of how the organization actually operates (AN7) Monitoring of internal business needs and the capability of IS to meet those needs (AN8)	
Cooperation	Developing clear guidelines of managerial responsibility for plan implementation (CO1) Identifying and resolving potential sources of resistance to IS plans (CO2) Maintaining open lines of communication with other departments (CO3) Coordinating the development efforts of various organizational subunits (CO4) Establishing a uniform basis for prioritizing projects (CO5) Achieving a general level of agreement regarding the risks/tradeoffs among system projects (CO6) Avoiding the overlapping development of major systems (CO7)	
Capabilities	Ability to identify key problem areas (CA1) Ability to anticipate surprises and crises (CA2) Flexibility to adapt to unanticipated changes (CA3) Ability to gain cooperation among user groups for IS plans (CA4)	

The results indicate that executives should pay attention to implementing Situational Analysis with greater meticulousness, so they can apply Strategy Conception and Strategy Implementation Planning with greater agility rather than now. Planners should analyze their current business systems, organizational systems, IS, as well as business environment and external IT environment. If planners understand those elements they can improve the result of the planning process excluding the increased time and cost which the process is needed. When executives understand the environment, they can determine important IT objectives and opportunities for improvement, they can evaluate them in order to define high level IT strategies in their business' strategy conception (Kamariotou *et al.*, 2018; Mirchandani & Lederer, 2014; Zubovic *et al.*, 2014).

The productiveness of internal processes is increased by the use of IT supporting the competitiveness of the organization to secure rare resources and to operate as a modulator against changes. An information processing is necessary to high-light limiting coordination costs, increasing inner control, improving the productiveness of internal methods, minimizing both costs of functions and costs of handling data. Finally, the use of IT helps the business to boost the relationship with customers by learning more about their needs. The use of IT help the business to reduce uncertainty as it is able to concentrate more on quickly changing consumer demands and reduce response times, increasing firm performance. As a result, customers are satisfied and conduce to the increase of firm performance. It also allows the business to develop differential products that customers need or to provide more efficient services when business offers their existing products (Fairbank *et al.*, 2006).

After the analysis of previous surveys, this study examines the relationship between profitability and the SISP phases, Strategic Awareness, Situation Analysis, Strategy Conception, Strategy Formulation and Strategy Implementation. The aim of this survey is the association of two important topics relationship constitutes a challenge for further research. Based on

previous findings and regarding previous researchers highlighted the effect of SISP on firm performance (Lederer & Sethi, 1996) the following hypotheses were indicated in order to be tested:

Strategic Awareness should concentrate on the planning process and on gaining appropriate knowledge about competitors, resources, customers and regulators. The understanding of that knowledge could be achieved through careful organization of the teams. Top management commitment provides greater organizational confidence and continual financial support for the process. Hence:

H1: Strategic Awareness positively affects firm's profitability.

Situation Analysis which focuses on the analysis of the business, organization and IS, would produce better knowledge about the organization's requirements. The analysis of external business and IT environments would help produce better knowledge about the effect of change and provide a better foundation for the plan, making it more possible to produce better results. Hence:

H2: Situation Analysis positively affects firm's profitability.

Strategy Conception, with recognition and assessment of opportunities, would provide more realistic alternatives. Recognition of IT objectives would enable the organization to align future IT and business objectives. Better alternatives and choices would support the plan produce better results. Hence:

H3: Strategy Conception positively affects firm's profitability.

Strategy Formulation includes the identification of the plan itself as far as processes, architectures, and projects. When the identification of the plan is careful, it would make it more possible to meet planning objectives. Better prioritization would result in greater likelihood of implementation and greater chance of meeting objectives. Hence:

H4: Strategy Formulation positively affects firm's profitability.

Finally, Strategy Implementation Planning, with more attention to change management and a better action plan, would be more possible to achieve good implementation. Better control would result in more of the plan being implemented and as a result better delivery of planning goals. Hence:

H5: Strategy Implementation positively affects firm's profitability.

SISP is a formal process and SMEs can implement it to define IS strategy and apply the most suitable IS for their needs. This process encourages businesses to make decisions on the planning and the implementation of IS, analyzing their re-sources considering both the environmental opportunities and the threats. Moreover, SISP involves all the factors and the activities which are shown above as the benefits of the formalization. Mirchandani and Lederer (2014), investigated SISP phases and they discussed that as the environment becomes more complex, more Situational Analysis is required. The analysis of current business systems, organizational systems and IS, as well as current external, internal business environment and current external IT environment permit the organization to determine problems and diagnose opportunities. So, more research in the implementation of this process will highlight the phases that contribute more in the success of the process. This will enable managers to improve the activities of these phases and to be more effective.

METHODOLOGY

A field survey was developed for IS executives. The instrument used five-point Likert-scales to operationalize two constructs: SISP phases and business performance. The SISP process constructs measured the extent to which the organization conducted the five planning phases and their tasks. The business performance measured using four dimensions named profitability, market share, number of new products to the market, customer satisfaction. The questionnaire was based on previous surveys regarding SISP phases and performance (Andersen, 2001; Brown, 2004; Cao & Schniederjans, 2004; King & Teo, 2000; Kitsios & Grigoroudis, 2014; Kitsios *et al.*, 2015; 2009; Maharaj & Brown, 2015; Mentzas, 1997; Mirchandani & Lederer, 2014; Newkirk & Lederer, 2006; Newkirk *et al.*, 2008; 2003).

Four IS executives were asked to participate in a pilot test. Each one completed the survey and commented on the contents, length, and overall appearance of the instrument. Then, the sample of this survey was IS executives in Greece and it was selected from the icap list (Newkirk & Lederer, 2006; Newkirk *et al.*, 2003). SMEs which provided contact details were selected as the appropriate sample of the survey. Thus, the survey was sent to 1246 IS executives and a total of 160 returned the survey. Data analysis was implemented using Multivariate Regression Analysis.

RESULT

The internal consistency, calculated via Cronbach's alpha, ranged from 0.812 to 0.856, exceeding the minimally required 0.70 level (Newkirk *et al.*, 2003; Pai, 2006). Table 3 presents the reliability statistics and Table 4 presents the results of regression analysis.

Table 3: Reliability statistics

Constructs	Scale Mean if Item deleted	Scale Variance if Item deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item deleted
Strategic Awareness	17,425	14,913	,642	,839
Situation Analysis	17,547	14,898	,584	,852
Strategy Conception	17,368	14,978	,733	,822
Strategy Formulation	17,566	15,258	,660	,835
Strategy Implementation	17,660	14,188	,778	,812
Firm Performance	18,000	17,086	,536	,856

Table 4: Coefficients^a

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.	Hypothesis
	B	Std. Error	Beta			
Constant	1,105	,305		3,620	,000	
Strategic Awareness	,006	,084	,088	,076	,940	H1 (-)
Situation Analysis	,038	,072	,053	,524	,602	H2 (-)
Strategy Conception	,214	,105	,254	2,048	,043	H3 (+)
Strategy Formulation	,265	,088	,324	3,022	,003	H4 (+)
Strategy Implementation	,031	,106	,040	,292	,771	H5 (-)

This study first analyzed the relationship between Strategic Awareness and firm's profitability. H1 found no support. As IS managers do not invest time on Strategic Awareness, they do not identify planning objectives and they are not committed. As a result this phase does not affect firm's profitability. Furthermore, Situation Analysis found no support (H2). Despite the fact that this phase is very important for IS executives in order to gather information about competitors, industry and customers, results show that they did not focus their attention on this phase (Newkirk & Lederer, 2006; Newkirk *et al.*, 2003). So, this phase does not increase firm's profitability. As predicted by H3, Strategy Conception indicates a positive relationship with firm's profitability ($\beta=0,214$, $p<0.005$). Consequently, H3 is supported. In contrast, previous findings show that more strategy conception does not, apparently, contribute to a better set of alternatives to managers in order to choose (Newkirk & Lederer, 2006; Newkirk *et al.*, 2003). Furthermore, H4 is supported since the Strategy Formulation has an important positive effect on firm's profitability ($\beta=0,265$, $p<0.005$). Finally, H5 found no support. The strategy implementation planning phase is especially interesting, because implementation is generally seen as the most crucial phase to success. Plans may be conceived and formulated but are seldom implemented. Unfortunately, the results of this survey show that managers do not implement their plans.

Results indicate that IS executives are not aware of analyzing the external IT environment and evaluating opportunities for IS development. This finding is crucial because it confirms that senior executives in SMEs do not invest in emergent technologies and cannot fit with the strategic, structural, and environmental dynamics. Furthermore, an important obstacle is that managers do not focus on organizing the planning team. Employees who will participate in the development of IS should have IT skills, motivation to develop effective IS and cooperation skills. This finding is associated with the lack of management support and the lack of clear guidelines about the IS development. IS executives should be able to define priorities, increase the cooperation among the IS team and provide guidelines regarding in order to support the effectiveness of IS plans and align them with business plans.

In response to anticipated changes in business environment, companies are developing IS at an increasing rate. Therefore, IT investment has been a significant issue for managers, as it is crucial budget items in most businesses. However, senior executives do not formulate IT strategies and priorities, so they cannot anticipate risks and crises. As managers cannot identify problem areas, they cannot redesign business processes. Thus, IS that are developed are based on the existing business processes and they cannot be aligned with IS objectives. This finding confirms the negative consequences that SMEs face due to the lack of strategic planning.

Management literature has shown results on the concentration of senior executives on Strategy Conception and Strategy Implementation. IT managers do not invest time on Strategic Awareness and Situation Analysis, as a result the implemented plans are not effective, successful and they do not meet business objectives (Brown, 2004; Kamariotou & Kitsios, 2019; 2017a; 2017b; 2016; Kitsios & Kamariotou, 2019a; b; c; Newkirk & Lederer, 2006; Newkirk *et al.*, 2003). Furthermore, managers who only concentrate on the implementation of the process, can achieve shorter SISP horizons but they cannot align strategic goals with IT ones. Senior executives do not pay attention to strategic objectives how IS can increase business value because they focus on the horizon of the project and on decrease of cost due to limited IT budget (Brown, 2004). The results of this survey indicate that managers who pay attention to implementing Situational Analysis with greater meticulousness, they can apply Strategy Conception and Strategy Implementation Planning with greater agility rather than now. Planners could analyze their current business systems, organizational systems, IS, as well as the business environment and external IT environment in order to align IT strategy with business strategy. Thus, the output of the planning process can be significantly improved

excluding the increased time and cost needed for the process. When executives understand the environment, they can determine important IT objectives and opportunities for improvement and they can evaluate them in order to define high-level IT strategies in their business' strategy conception (Arvidsson *et al.*, 2014; Burgelman *et al.*, 2018; Chen *et al.*, 2010; Kitsios & Kamariotou, 2016; Marabelli & Galliers, 2017).

CONCLUSION

So far, few academic researchers have paid attention to the effect of SISP phases on firm performance. This paper examines the contemporary impact of IT and business strategy on business performance, incorporating all these constructs into a model that is tested using Multivariate Regression Analysis. The results of this survey show that Strategy conception and formulation have a significant impact on business performance.

IT without strategic direction does not increase value to SMEs. SMEs should determine and communicate their vision, mission, business strategy and goals in order to align them with strategy and goals of IS. Managers in SMEs should be aware of IT issues in order to make better decisions for their businesses. This is difficult to be achieved when managers are not young and educated about IT. Frequently, they make decisions without focusing on the objectives of IS department and this can be an obstacle for SMEs profitability and competitiveness. Thus, a culture of innovation and supporting IT is required to increase SMEs benefits through the process of strategic alignment.

In order to develop sustainable performance in the current complex environment, SISP process is significant for businesses as it supports successful development and implementation of their IT projects. Implementing SISP process is a difficult task. It is necessary that businesses have multiple planning aspects by fully understanding their goals and strategies and facing up to their various issues. To conduct SISP process successfully, it is essential be that phases which have a positive impact on the process be taken into consideration.

The results of this study contribute to IS executives' awareness of the strategic use of IS planning in order to increase competitive advantage. Understanding those phases may help IS executives concentrate their efforts on organizations' objectives and recognize the greatest value of the planning process in their business. Second, the results of this survey can increase their awareness of the phases of SISP. IS executives should be knowledgeable about the five phases and they should not ignore the tasks of each one because this might be an obstacle which prevents the organization from achieving its planning goals and thus from realizing greater value.

A limitation of this study stems from the fact that the sample was not adequate. Nevertheless, the results of an exploratory study will be summarized in an improved conceptual model for further research. Also, this survey is made for SMEs. Future researchers could examine and compare these results with relative ones from large companies. Apparently, future researchers may use different methodologies for data analysis such as SEM.

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Finding Product Problems from Online Reviews Based on BERT-CRF Model

(Full Paper)

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ABSTRACT

Online product reviews contain a lot of valuable information regarding product problems, which are very useful for producers to find product pain points and improve product quality. However, many studies focus only on the sentiment polarity of the product aspect, ignoring specific product problem information in online reviews. In this paper, product aspects and specific problem information are extracted from online reviews to help producers find the specific pain points of products. We call this task *Review Problem Mining* (RPM). At the same time, existing methods of review information extraction depend heavily on manually constructed features or large-scale data. To address these limitations, we proposed a new joint model BERT-CRF which integrates the popular pre-trained language model BERT and conditional random fields (CRF). The proposed method introduces external knowledge through BERT to reduce the model's dependence on training data and uses CRF to model the dependencies among tags. To verify the validity of our method, we constructed a dataset from JD.com and carried out the experiments. Experimental results show that the proposed method is highly effective.

Keywords: Review problem mining; information extraction; BERT; CRF; deep learning; natural language processing.

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INTRODUCTION

With the development of internet technology and the popularization of e-commerce, more and more consumers like to shop online and post reviews on specific products. Therefore, there are a large number of reviews on e-commerce platforms. Online reviews provide consumers with more product information, which helps them make more informed purchasing decisions. Producers can also get timely feedback from consumers through online reviews, which can help producers understand consumer needs, find product pain points, and promote product innovation (H. Zhang, Rao, & Feng, 2018). However, it is difficult for ordinary people to process a massive volume of online reviews and extract consumer opinions in them. Thus, automatic review processing and opinion extraction techniques are needed. Sentiment analysis grows out of this need. Sentiment analysis (also called opinion mining or review mining) is the task of detecting, extracting and classifying opinions, sentiments, and attitudes concerning different topics, as expressed in textual input (Montoyo, MartiNez-Barco, & Balahur, 2012). It helps achieve a variety of goals, such as obtaining market intelligence, measuring customer satisfaction, identifying consumer needs, and more (Ravi & Ravi, 2015).

Researchers mainly study sentiment analysis from three levels: document-level, sentence-level, and aspect-level (L. Zhang, Wang, & Liu, 2018). The document-level and sentence-level sentiment analysis can identify the sentiment polarity of a document or sentence. However, consumers usually express different opinions on different aspects of the product in their reviews (e.g. "The screen is nice, but the performance is poor"), and document-level and sentence-level sentiment analysis cannot provide such detailed opinion information. Therefore, aspect-based sentiment analysis (ABSA) has attracted the attention of many researchers (Schouten & Frasincar, 2015). Compared with document-level and sentence-level sentiment analysis, aspect-based sentiment analysis is more fine-grained, it can identify the sentiment polarity of consumers to product aspects. (Hu & Liu, 2004).

However, Liu (2015) pointed out that for higher analysis needs, it is not enough to identify aspects and the polarities of each aspect only, more detailed analysis of reviews is needed. For example, in the sentence "The sound quality of the mobile phone is bad, there are some murmurs." the "sound quality" is a product aspect and "bad" is a sentiment word, aspect-based sentiment analysis techniques can identify consumers' negative opinion about the sound quality of the mobile phone. However, it is difficult for the producer to improve the product only based on the negative opinion, they need to know the specific problems of the product. In this sentence, we call "there are some murmurs" as a problem of the sound quality. In practical application, it is of great significance to identify problems in reviews, because producers can understand the specific pain points of products and services according to the problems, make targeted decisions to improve products and services quality (Liu, 2015).

Therefore, product aspects and specific problem information are extracted from online reviews in this work (e.g. Sound quality: There are often murmurs), and we call the task *Review Problem Mining* (RPM). Compared to aspect-based sentiment analysis, which only concerns sentiment polarity in aspect-level, RPM concentrates on the extraction of specific problems in reviews. Therefore, RPM can provide producers with more fine-grained and targeted product problem information to help them improve their products.

Review information extraction is typically modeled as a sequence labeling task. The most commonly used model is conditional random fields (Lafferty, McCallum, & Pereira, 2001). However, the effect of conditional random fields (CRF) model depends heavily on manually constructed features, the process of constructing features is inefficient. With the development of deep learning technology, many studies apply deep learning to review information extraction recently (L. Zhang, Wang, & Liu, 2018). Deep learning models can automatically learn the features of the text, but they also require large-scale data to train their models, the lack of annotated review data limits the performance of them.

Recent studies have shown that the use of language models pre-trained with large-scale data is useful for a variety of NLP tasks (Devlin *et al.*, 2018; Peters *et al.*, 2018; Radford *et al.*, 2018). Therefore, to address the existing limitations of current methods, we proposed a joint model BERT-CRF which integrates the popular language model BERT (Devlin *et al.*, 2018) and CRF to extract the aspects and problems from online reviews. Bidirectional Encoder Representations from Transformers (BERT) is one of the critical innovations in the field of natural language processing, and it has achieved great success in many NLP tasks. Its main idea is to learn a lot of prior language knowledge from a large amount of unsupervised corpus through the language model task, and then to fine-tune on specific downstream tasks. Therefore, it can perform well on limited data. The proposed method fine-tunes BERT to learn the features of online reviews and uses CRF to model the dependencies among tags. To evaluate the proposed method, we constructed a dataset from JD.com, which contained 7645 annotated reviews. Experimental results show that the proposed method outperforms other popular methods at present, such as BI-LSTM-CRF.

The main contributions of this paper are as follows: (1) It proposed a new task called *review problem mining* (RPM), which can help producers find problems in products and services efficiently. (2) It proposed the BERT-CRF model for RPM based on the limitations of current methods. Experimental results show the effectiveness of the proposed method. This method can also be applied to some other review information extraction tasks such as aspect extraction (AE).

RELATED WORK

Existing research has produced numerous methods for various tasks of review information extraction, which include both supervised learning and unsupervised learning methods. Unsupervised learning methods usually rely on the dictionary or syntactic rules. Hu and Liu (2004) used association rules to extract frequent nouns and noun phrases as aspects, and the adjectives closest to aspects as sentiment words. Qiu *et al.* (2009) proposed a double propagation method, given a set of sentiment words, which can use the dependencies between the aspect words and the sentiment words to identify new aspects and sentiment words in the reviews. Samha, Li, and Zhang (2014) identified aspects by querying related domain aspect name and synonym information in the WordNet dictionary. García-Pablos, Cuadros, and Rigau (2018) developed an unsupervised opinion mining system based on the topic model, which can automatically identify aspect words and sentiment words in reviews by given aspect and sentiment seeds. Im *et al.* (2019) proposed a method called confirmatory aspect-based opinion mining, which first splits the reviews into a set of clauses, then parses the clauses into a set of aspect-sentiment word pairs. These unsupervised methods most rely on the manual construction of dictionaries and syntactic rules, which is very time-consuming. At the same time, they crucially depend on the grammatical accuracy of the sentences.

Supervised learning methods are successfully applied to review information extraction. Jin, Ho, and Srihari (2009) proposed a lexicalized HMM model, which can identify aspects and sentiment words in reviews and determine the sentiment polarity. Jakob and Gurevych (2010) adopted conditional random fields (CRF), introduced features such as part of speech tags, tokens, short dependency paths, word distances to extract aspects from online reviews. Xiang, He, and Zheng (2018) used the kmeans++ algorithm to acquire multi-feature embedding and word clustering features and input these additional features to the CRF model for training. Laddha and Mukherjee (2018) proposed a hybrid method, LDA-CRF, which uses CRF to extract aspects and sentiment words, and then predicts sentiment scores through a regression method. These methods depend on manual construction and selection of features, which requires a lot of manual effort.

With the development of deep learning technology, many scholars apply deep learning to review information extraction. Poria, Cambria, and Gelbukh (2016) used a 7-layer deep convolutional neural network (CNN) to extract aspects from the reviews. Meanwhile, they developed a set of linguistic patterns and integrated them into the model. Wang *et al.* (2016) proposed a joint model RNCRF to extract aspects and sentiment words from the reviews, it can learn the high-level features and double propagates information between aspect and sentiment words. Jabreel, Hassan, and Moreno (2018) proposed a Bidirectional Gated Recurrent Unit (GRU) network model, the model can identify aspects in the tweet and the polarities of tweet towards each aspect. Wu *et al.* (2018) proposed a hybrid unsupervised method to extract aspects. The method first uses linguistic rules to extract phrase blocks as candidate aspects, and then it uses these texts with extracted chunks as pseudo annotated data to train a GRU network. Al-Smadi *et al.* (2019) used a character-level bidirectional long short-term memory (LSTM) along with CRF to extract aspects from reviews. These deep learning methods need many annotated data to train their models. The lack of annotated review data limits the performance of these methods.

Related researches mainly focus on the extraction of aspects and sentiment words, ignoring the extraction of specific product problems. Unlike them, RPM focuses on the extraction of specific problems in reviews, which helps producers find the pain points of products and improve the quality of products. Meanwhile, existing methods of review information extraction rely

heavily on manual constructed features or large-scale training data. In order to address these limitations, we proposed a new joint model BERT-CRF. Experimental results show the effectiveness of our method.

MODEL DESCRIPTION

The pre-training of large language models requires large-scale data and sufficient computing resources. Therefore, redesigning and pre-training a language model is very expensive and unnecessary for most research works. In this paper, we choose Google's open-source pre-trained language model BERT as the basis of our model. In addition, there are strong dependencies among tags in the sequence labeling task, so we introduce the CRF layer to model the dependencies. In this section, we first introduce the basic architecture of BERT and CRF and then introduce the proposed joint model BERT-CRF in detail.

BERT

BERT (Devlin *et al.*, 2018) is one of the most critical developments in the recent progress of the pre-trained language model (Peters *et al.*, 2018; Radford *et al.*, 2018). The idea behind the progress is that even if the word embeddings are trained from a large-scale unsupervised corpus, it is not enough to learn the contextual representation of the word only through limited supervised data on end tasks. BERT is based on a multi-layer bidirectional transformer encoder (Vaswani *et al.*, 2017), it aims to learn deep contextual representations of words by pre-training on large-scale unsupervised data. It adopts a fine-tuning approach, which can be applied to many downstream NLP tasks.

Input representations

The input of BERT can be a single sentence or a pair of sentences, which are processed in slightly different ways. Since our task is a sequence labeling task, we will introduce the processing mode of a single sentence. In the task of a single sentence, each sentence is converted into a token sequence. The first and last tokens of each token sequence are special tokens ([CLS] and [SEP]). In the pre-training process of BERT, [CLS] is used to encode the information of the whole token sequence, and [SEP] is used to distinguish two sentences. They are not crucial for our task, but in order to be consistent with the pre-trained language model, they need to be preserved. For Chinese, each of the remaining tokens in the token sequence is a Chinese character. As shown in Figure 1, for each token in a token sequence, its input embedding is the sum of corresponding token embedding, segment embedding, and position embedding. Token embedding is related to the specific token. Segment embedding is intended to indicate which sentence the token belongs to, and all segment embeddings are the same for a single sentence. Position embedding is intended to represent the position of the token in the token sequence.

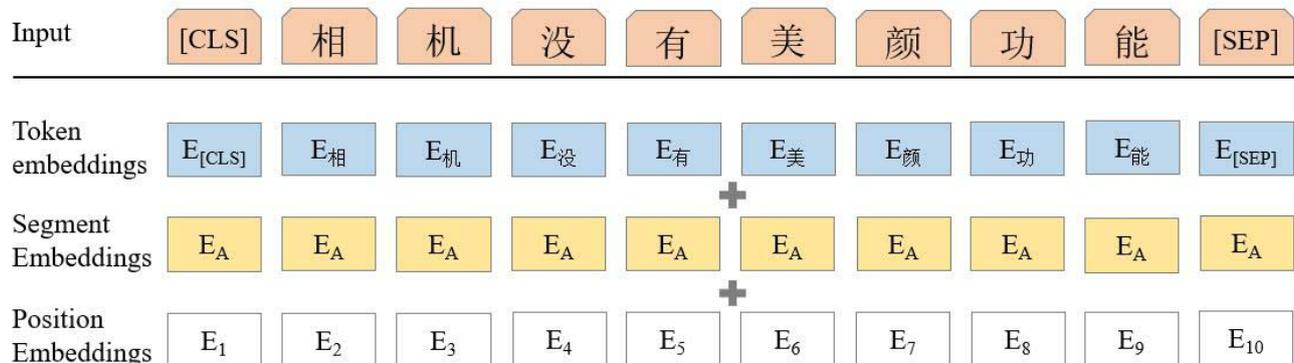


Figure 1: The input representations of BERT

BERT architecture

BERT uses a multi-layer bidirectional transformer encoder instead of BI-LSTM. Compared to LSTM that processes the sequence step by step, the transformer can process the entire sequence in parallel, which speeds up the calculation. Figure 2 shows the architecture of BERT. Given a token sequence $s = (t_1, t_2, \dots, t_N)$, its input embeddings are formulated as $\vec{x} = (\vec{x}_1, \vec{x}_2, \dots, \vec{x}_N)$, where \vec{x}_i is the input embedding for t_i , N is the number of tokens in the token sequence. Then \vec{x} goes through multi-layer transformer blocks. Finally, we obtain the hidden states of the last layer (the output of the last transformer block) $\vec{h} = (\vec{h}_1, \vec{h}_2, \dots, \vec{h}_N)$. These hidden states can be considered as the features of the text, and they can be used for various NLP tasks such as sentence classification and sequence labeling.

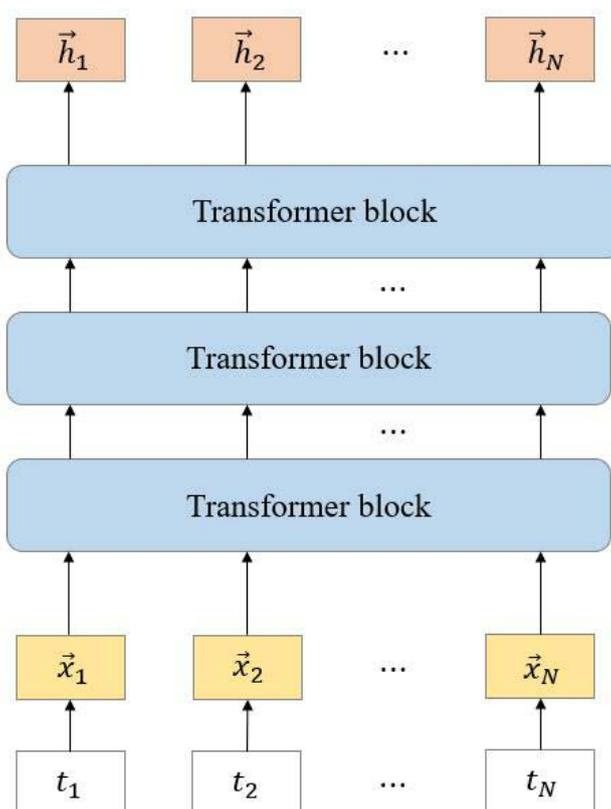


Figure 2: The architecture of BERT

Each transformer block includes a self-attention layer and a fully connected layer. transformer relies entirely on the self-attention mechanism to obtain context information so that it can compute in parallel. Figure 3 shows the architecture of a transformer block. Because introducing the transformer is not the focus of this paper, we will omit an exhaustive description of the transformer and refer readers to (Vaswani *et al.*, 2017).

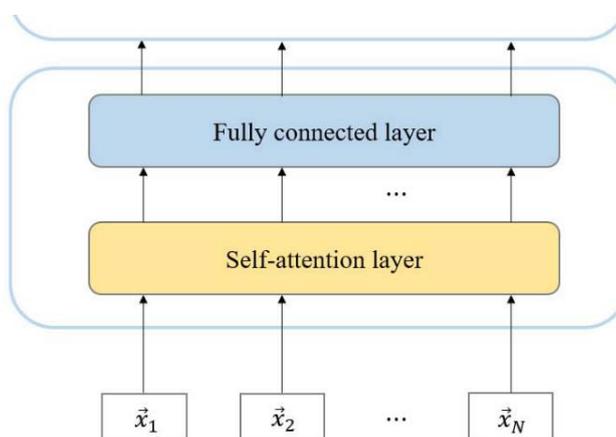


Figure 3: The architecture of a transformer block

BERT was pre-trained on the large-scale document-level corpus using masked language model task (Taylor, 1953) and predicting the next sentence task. For Chinese, the parameters of BERT are set as follows:

BERT_{BASE}, Chinese:12-layer, 768-hidden, 12-heads (in transformer), 110M parameters.

The Chinese model was pre-trained on Chinese Wikipedia articles, and we will fine-tune this language model on our dataset.

CRF

Conditional random fields (CRF) (Lafferty, McCallum, & Pereira, 2001) is a conditional probability distribution model, it calculates the joint probability of a tag sequence under a given observation sequence. Linear-chain conditional random fields (linear-chain CRF) is the most commonly used conditional random fields model in the field of natural language processing,

which is widely used in various sequence labeling tasks (CRF mentioned in this paper refers to linear-chain CRF). Its basic architecture is shown in Figure 4. Given an observation sequence $x = (x_1, x_2, \dots, x_N)$ and a tag sequence $y = (y_1, y_2, \dots, y_N)$, the probability $P(y|x)$ of the tag sequence corresponding to x being y is as follows:

$$P(y|x) = \frac{1}{Z(x)} \exp \left(\sum_{i,k} \lambda_k t_k(y_{i-1}, y_i, i) + \sum_{i,l} \mu_l s_l(y_i, x, i) \right) \quad (1)$$

$$Z(x) = \sum_y \exp \left(\sum_{i,k} \lambda_k t_k(y_{i-1}, y_i, i) + \sum_{i,l} \mu_l s_l(y_i, x, i) \right) \quad (2)$$

Where $Z(x)$ is a normalized factor, $t_k(y_{i-1}, y_i, i)$ is the transition function, representing the score of the transition from the tag y_{i-1} at the position $i-1$ to the tag y_i at the position i . $s_l(y_i, x, i)$ is the state function, representing the score of the tag is y_i on the position i of the tag sequence. The values of these two functions are usually 1 or 0. λ_k and μ_l are the weights of the transition function and state function.

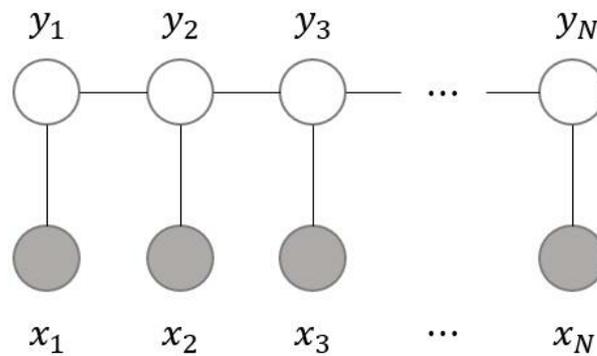


Figure 4: Linear-chain CRF

BERT-CRF Model

Although BERT can well learn the features of the text, it cannot model the dependencies among output tags (e.g. meaningful tags always start with B). Therefore, it is necessary to model the dependencies among tags using CRF. We combine BERT and a CRF layer to form the BERT-CRF model, which is shown in Figure 5. This model can efficiently learn the features of text via BERT and obtain sentence-level tag information via a CRF layer. The CRF layer has a transition matrix as parameters. With such a layer, we can effectively use the surrounding tags to predict the current tag.

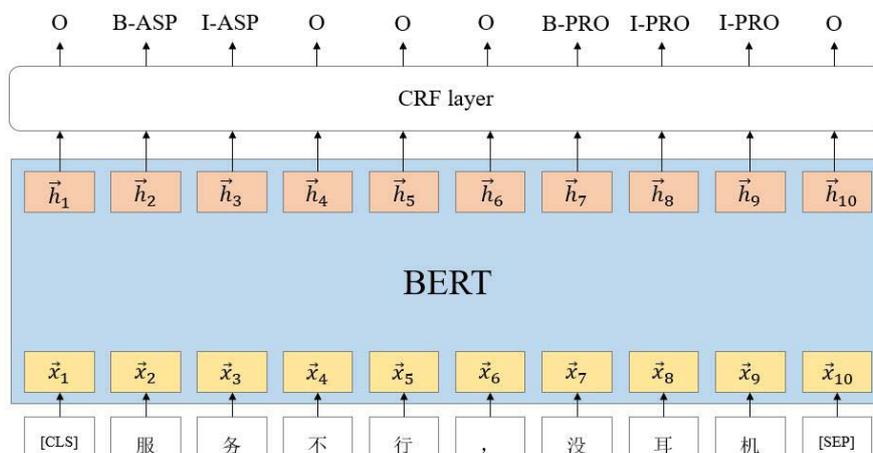


Figure 5: The architecture of BERT-CRF

Given a token sequence $s = (t_1, t_2, \dots, t_N)$, its input embeddings are $\bar{x} = (\bar{x}_1, \bar{x}_2, \dots, \bar{x}_N)$. After a multi-layer transformer encoder, we first obtain the hidden states of BERT's last layer as $\bar{h} = (\bar{h}_1, \bar{h}_2, \dots, \bar{h}_N)$, where $\bar{h}_i \in \mathbb{R}^H$, H is BERT's hidden dimensions, equal to 768. Then \bar{h} is converted to the matrix φ by the parameter matrix W_φ :

$$\varphi = \bar{h}^T \bullet W_\varphi \quad (3)$$

Where $W_\varphi \in \mathbb{R}^{H \times K}$, K is the number of tags. $\varphi \in \mathbb{R}^{N \times K}$ is the score matrix, and φ_{i, y_i} is the score of the tag is y_i on the position i of the tag sequence. To model the dependencies among tags, we introduce a state transition parameter matrix $A \in \mathbb{R}^{K \times K}$, A_{y_{i-1}, y_i} is the score of the transition from the tag y_{i-1} to tag y_i . We now denote BERT's parameters as θ , and the parameters of BERT-CRF are $\tilde{\theta} = \theta \cup W_\varphi \cup A$. For a prediction sequence $\hat{y} = (\hat{y}_1, \hat{y}_2, \dots, \hat{y}_N)$, we formulate its score to be:

$$sc(s, \hat{y}, \tilde{\theta}) = \sum_{i=1}^N A_{\hat{y}_{i-1}, \hat{y}_i} + \sum_{i=1}^N \varphi_{i, \hat{y}_i} \quad (4)$$

The softmax function over all possible tag sequences produces the probability $P(\hat{y} | s, \tilde{\theta})$ of the sequence \hat{y} :

$$P(\hat{y} | s, \tilde{\theta}) = \frac{\exp(sc(s, \hat{y}, \tilde{\theta}))}{\sum_{\tilde{y} \in Y_s} \exp(sc(s, \tilde{y}, \tilde{\theta}))} \quad (5)$$

Where Y_s is the set of all possible tag sequences for s . We denote the correct tag sequence as $y = (y_1, y_2, \dots, y_N)$, during the training, we maximize the log-probability $L(\tilde{\theta})$ of y :

$$L(\tilde{\theta}) = \log P(y | s, \tilde{\theta}) \quad (6)$$

As can be seen from the above formula, we want the model to generate a meaningful tag sequence. When decoding, dynamic programming (Rabiner, 1989) can be used to obtain the optimal tag sequence. we predict the tag sequence that obtains the maximum score given by:

$$y^* = \operatorname{argmax}_{\tilde{y} \in Y_s} sc(s, \tilde{y}, \tilde{\theta}) \quad (7)$$

The training procedure of the BERT-CRF model is shown in Algorithm 1. In each epoch, we divide the data into multiple batches and feed one batch into the model each time. For each batch, we first run the BERT-CRF model forward pass. As a result, we obtain a loss $L(\tilde{\theta})$. We then run the BERT-CRF model backward pass to compute gradients for all model parameters $\tilde{\theta}$. Finally, we update all parameters $\tilde{\theta}$.

Algorithm 1: BERT-CRF training procedure

```

1: for each epoch do
2:   for each batch do
3:     1) BERT model forward pass
4:     2) CRF layer forward pass
5:     3) calculate the loss
6:     4) CRF layer backward pass
7:     5) BERT model backward pass
8:     6) update parameters
9:   end for
10: end for

```

EXPERIMENTS

In this section, we will introduce our experiments. The primary process of the experiments is shown in Figure 6. Besides, in

order to verify the effectiveness of our method, we also compared three commonly used methods of review information extraction at present and reported the comparison results.

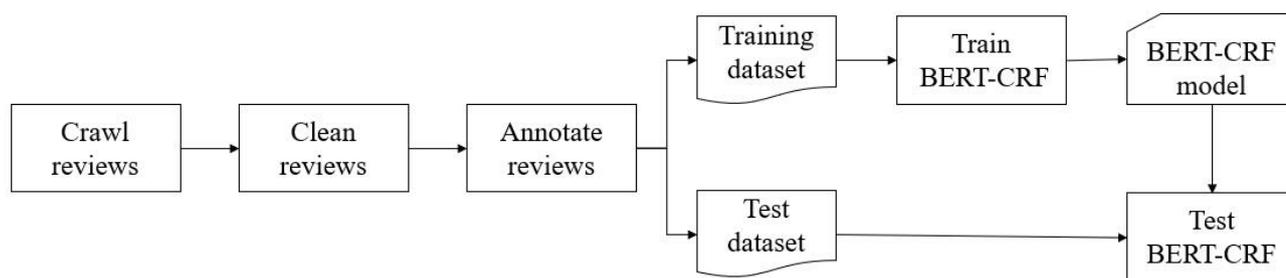


Figure 6: The experimental process

Dataset

Data collection and preprocessing

As there are no existing datasets for RPM, we constructed a dataset. We developed a web crawler using python and used the crawler to crawl 190251 mobile phone reviews from JD.com, then we cleaned the original reviews and got 172200 valid reviews.

The review cleaning process includes: (1) Delete the system default praise; (2) Delete the reviews without Chinese characters; (3) Convert uppercase English letters in the reviews to lowercase English letters; (4) Convert the traditional characters in the reviews to simplified characters; (5) Delete special symbols in the reviews, such as emoticons; (6) Delete duplicate reviews; (7) Delete the reviews with length less than 3.

We did not carry out Chinese word segmentation, because: (1) BERT was pre-trained based on Chinese characters, our input format needs to be consistent with the pre-trained language model. (2) For Chinese, especially social network corpus, the effect of existing word segmentation tools is not very ideal. Inaccurate segmentation results will mislead training and reduce the effect of model, deep learning models should learn such knowledge from data.

Data annotation

Since BERT-CRF is a supervised learning method, data annotation is required. We annotated 7600 reviews, the length distribution of which is shown in Figure 7.

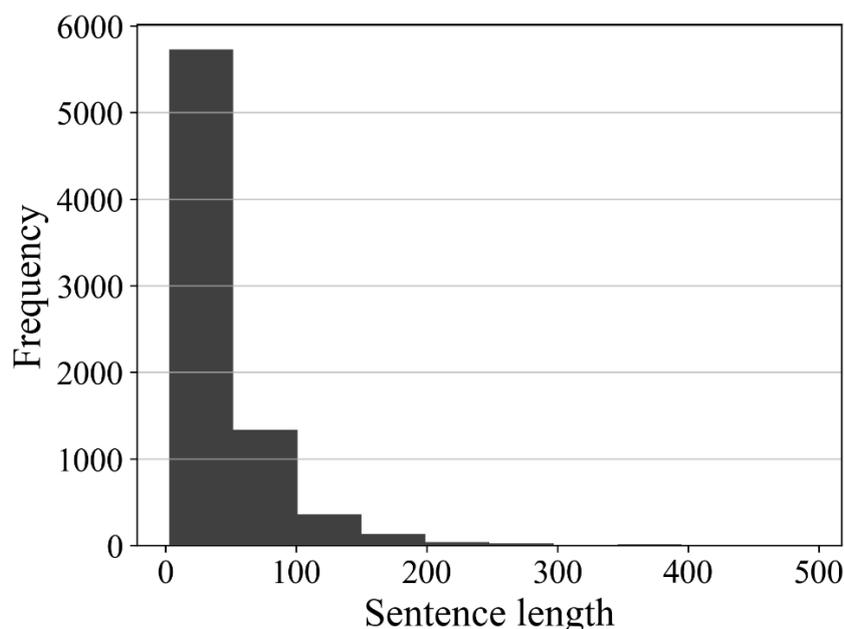


Figure 7: The length distribution of reviews

Neutral and negative reviews are usually shorter than positive reviews. To ensure the balance of the data, there are more neutral reviews and negative reviews than positive reviews in the annotated reviews. The specific distribution is shown in Figure. 8.

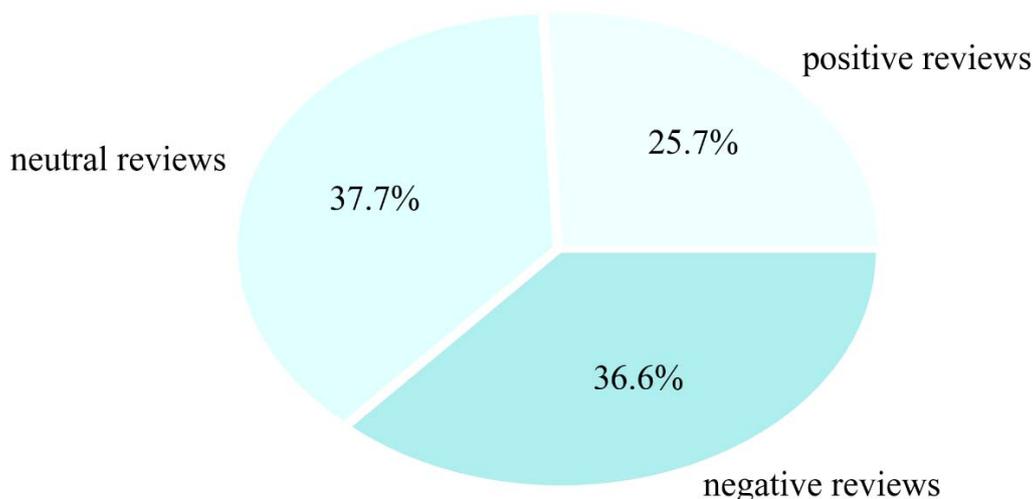


Figure 8: The distribution of positive reviews, neutral reviews, and negative reviews

In the sequence labeling task, each character in the text is assigned a tag. Because the aspects and problems are usually composed of multiple characters, a unified tagging scheme is needed. In this paper, we follow the BIO (Beginning, Inside, and Other) tagging scheme. We use ASP for aspect, PRO for problem and O for others, and then we have five tags {B-ASP, I-ASP, B-PRO, I-PRO, O}, where B-, I- indicate beginning and inside positions of the aspect or problem.

To ensure the quality of the annotation, 7,645 reviews were annotated by the same annotator. Then we divided the annotated reviews data into the training dataset and test dataset according to the ratio of 7:3. Table 1 shows the basic information on the training dataset and test dataset.

	reviews	tokens	B-ASP	I-ASP	B-PRO	I-PRO
training set	5353	208171	8286	11967	2050	2922
test set	2292	90175	3497	5060	930	1290

Table 2 shows an example of the training data.

充	电	口	部	分	有	白	点
B-ASP	I-ASP	I-ASP	O	O	B-PRO	I-PRO	I-PRO
,	屏	幕	偶	尔	会	黑	屏
O	B-ASP	I-ASP	O	O	O	B-PRO	I-PRO

Pre-trained character embeddings

BERT-CRF does not require pre-trained character embeddings as input, but the models for comparison require that for better results. Therefore, we adopt the 172200 reviews after cleaning as character embeddings training corpus and then used the skip-gram model (Mikolov *et al.*, 2013) to generate character embeddings. The dimension of each character embedding is set to 100, and the window size is set to 5.

Experimental Settings

We program in python and develop the model using the deep learning framework TensorFlow. Our experiment is implemented on the hardware with NVIDIA GeForce GTX 1080Ti.

Hyper-parameters

We adopt **BERT**_{BASE} as the basis for our model, it has 12 layers, 768 hidden dimensions, and 12 heads of self-attention. We apply dropout to \bar{h} with a dropout rate of 0.1. The max sequence length is set to 128. We use Adam optimizer with the learning rate of $5e-5$, warmup proportion of 0.1. We train 10 epochs on the training dataset with a batch size of 32.

Compared methods

In order to verify the effectiveness of the proposed method, we compared several commonly used methods of review information extraction at present. We have three baselines: CRF, BI-LSTM-CRF, BI-GRU-CRF.

CRF: Conditional random fields (Lafferty, McCallum, & Pereira, 2001) is a classic method of sequence labeling. We use the open-source tool CRF++ to implement the CRF model and provide the context characteristics of each character to the CRF model for training.

BI-LSTM-CRF: BI-LSTM-CRF (Lample *et al.*, 2016) can use past and future input features via a BiLSTM network and sentence-level tag information via a CRF layer. LSTM (Graves & Schmidhuber, 2005; Hochreiter & Schmidhuber, 1997) is one of the most common variants of recurrent neural networks (RNN), it is better at discovering and exploiting long-range dependencies in data than RNN. We use the pre-trained character embeddings as the input of BI-LSTM-CRF.

BI-GRU-CRF: This method is similar to BI-LSTM-CRF, except that it uses the GRU cell instead of the LSTM cell. GRU (Cho *et al.*, 2014) cell is a simplification of LSTM cell, and it can also model long-range dependencies in data. We also use the pre-trained character embeddings as the input of BI-GRU-CRF.

The hyper-parameter settings for all models are shown in Table 3.

Table 3: The hyper-parameter settings

hyper-parameter	BERT-CRF	BI-LSTM-CRF	BI-GRU-CRF	CRF
character embedding dimensions	768	100	100	-
hidden dimensions	768	100	100	-
max sequence length	128	128	128	128
optimizer	Adam	Adam	Adam	-
learning rate	5e-5	1e-3	1e-3	-
epochs	10	60	60	200
dropout rate	0.1	0.6	0.5	-
cost parameter	-	-	-	3

Evaluation metrics

In this paper, we use precision, recall, and F1 score as the evaluation metrics of the experimental results. In practice, we prefer to identify as many problems as possible in reviews, so recall and F1 score are major evaluation metrics. Meanwhile, in a sequence labeling task, we pay more attention to meaningful tags, so the tag O is not considered in the calculation. The evaluation metrics are calculated by the following formulas:

$$\text{precision} = \frac{TP}{TP + FP} \quad (8)$$

$$\text{recall} = \frac{TP}{P} \quad (9)$$

$$F1 = \frac{2}{1/\text{precision} + 1/\text{recall}} \quad (10)$$

Where TP indicates that the example is positive and the prediction result is true. FP indicates that the example is positive, but the prediction result is false. P indicates all positive examples. In this paper, the positive examples refer to the aspects or problems in the reviews. F1 score is twice the harmonic mean of precision and recall.

Table 4: The experimental results

aspects			problems		
precision	recall	F1	precision	recall	F1

CRF	94.04	93.09	93.56	72.72	51.92	60.59
BI-GRU-CRF	92.51	93.71	93.11	75.06	73.83	74.44
BI-LSTM-CRF	91.64	94.83	93.21	75.28	73.06	74.16
BERT-CRF	94.37	95.85	95.11	76.66	78.25	77.45

Result Analysis

We report all models' performance on test data in Table 4. We observed that the proposed joint model BERT-CRF converges faster, and its precision, recall, and F1 score are better than other models. We believe that the main reason is that BERT was pre-trained on the large-scale corpus, it has much prior knowledge so that it can perform better on limited annotated examples.

We noticed that the extraction effect of all models on the problems is much lower than that on the aspects. We suspect that there are two reasons: (1) The number of problems in the training data is less than the number of aspects, the lack of training examples leads to the reduction of extraction effect. (2) The aspect expressions in the reviews are relatively fixed and straightforward, with apparent features. However, the problem expressions are very complex, often a phrase or clause, which makes them challenging to extract.

We found that the precision of the CRF model is well, but the recall is significantly lower than other models, which indicates that the generalization ability of the CRF model is insufficient. We suspect the reason is that CRF is a shallow machine learning model, which relies heavily on manually constructed features. Therefore, it does not well identify examples that do not appear in the training data. Deep learning models can automatically learn the high-level features of the text, such as semantic features, so they have better generalization ability. Generalization ability is beneficial for problem extraction because problem expressions are usually very diverse and arbitrary, the powerful generalization ability enables the model to identify the examples that do not appear in the training data.

CONCLUSION

We proposed a new task called *review problem mining* (RPM). Compared with aspect-based sentiment analysis, which focuses on the sentiment polarity of aspect, RPM focuses more on the extraction of product problem information in reviews, which is helpful for producers to find the specific pain points of products and improve the quality of products. Meanwhile, to address the limitations of current methods of review information extraction, we proposed a new joint model BERT-CRF, which introduces external knowledge through BERT to reduce the model's dependence on data. To verify the effectiveness of the proposed method, we constructed a dataset from JD.com and carried out experiments. Experimental results show that the proposed method is highly effective. This method can also be applied to other review information extraction tasks such as aspect extraction and sentiment word extraction.

However, this study still has some limitations. For example, the BERT used in our work was pre-trained on Wikipedia articles and has almost no understanding of the review text, which leads to BERT's lack of domain knowledge and limits the effect of the model. Future research can post-train BERT on a large-scale review corpus in the domain of e-commerce, which may make the model perform better. Moreover, some problem expressions in reviews are very long, so how to extract these long problem expressions is also an important research topic in the future.

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Implementing Industry 4.0: Exploring the literature in a systematic way using text mining

(Full Paper)

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ABSTRACT

The increasing popularity of digitisation practices and methods by scholars and practitioners alike has been paving the way for industrial transformation. Industry 4.0 has become an accepted trend across various industries, yet despite the increasing number of articles on this topic the complexities of implementation at the firm level remains largely vague and undefined. Therefore, the research presents a review of the social, operational and strategic aspects following the full-text mining of 116 selected articles. The study reveals that digital transformation requires stakeholders and investors to consider implementation through a multi-level and multidisciplinary lens. On this basis the study identifies the social, operational and strategic gaps within the literature and provides recommendations for future studies on implementation.

Keywords: Industry 4.0, IIoT, CPPS, Implementation, Systematic review

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INTRODUCTION

Academic research on Industry 4.0 (I 4.0) has been increasing in popularity among scholars in the last decade. However, due to the multifaceted nature of Industry 4.0 and the fact that it is very much a novel and ongoing process, academic contributions mainly focus on the technical aspects (Primarily engineering and computer science) as opposed to the managerial or business aspects of I 4.0. The asymmetrical approach of the academic community to I 4.0 necessitates further contributions from the management science academic community (Liao et al, 2017). Schneider (2018) divides the academic approach of scholars of I 4.0 into two main groups, namely: researchers aiming to clarify the impact of I 4.0 on specific markets by quantification and subsequent evaluation of performance metrics, termed “distinct industry 4.0 research”. In contrast, the second category, termed “Industry 4.0 as a promising context”, aims to study established research fields such as supply chain management (SCM) and entrepreneurship within the context of I4.0 by further investigating the implications of implementation. Liboni et al (2019) support a similar division of academic studies by classifying priory research into “*Industry 4.0 as the central emphasis*” and “*Industry 4.0 as support to other discussions or technical aspects*”.

The main distinguishing factor of I 4.0 in comparison to previous trends is the utilization of cyber physical systems (CPS) or cyber physical production systems (CPPS) within the context of manufacturing, enhanced by the industrial internet of things (IIoT) to interlink the various elements of production into a reliable and continuous loop of information sharing. It is worth mentioning, however, that the term “Industry 4.0” has been interchangeably used with “Industrial internet of things” or IIoT in the extant literature (Müller, Kiel, and Voigt, 2018). The surge of scholarly publications on this topic has been steadily increasing but the progress across academic disciplines remains uneven, Schneider (2018). The division of academic work on “Industry 4.0” can be further clarified by subdividing extant publications by academic category or subject area. As illustrated by table 1, dividing prior research papers from Scopus (5,599 results) and Web of Science (3,304 results) databases without setting any search limitations provides a holistic view of the subject areas that are prioritized by the academic community. As of July 2019, both databases reveal a higher number of published papers in the engineering and computer science fields, with the social science and management fields lagging behind in terms of published content. Furthermore, the increasing volume of research papers published within the field of I 4.0 focuses in depth within a specific sector or technology, while the underlying concepts of I 4.0 remain isolated within and across many research fields. This is particularly true within the social sciences and particularly within the field of business and management, as many topics remain vague, ill defined, and dependent on the interpretation of the scholars, necessitating a holistic review of the literature and subsequent identification of the most significant research gaps that need to be addressed. The current review aims to add to the I 4.0 body of knowledge by examining only implementation-related papers and providing a quantitative analysis of the selected papers through data mining. In comparison precious works only examine I 4.0 by examining emerging management trends (Schneider, 2018) or only included the abstracts of the papers into the TDM (Galati and Bigliardi, 2019).

The primary objective of the present review of the literature is (i) to provide a holistic view of the current trends in I 4.0 from a managerial implementation lens to identify the overarching themes and (ii) to conduct a systematic literature review within each theme to illustrate the academic progress within as well as across the themes. The priority of the present study is to identify, select and ultimately analyse papers that exemplifying real-life use cases and pilot programs of I 4.0 initiatives across a variety of industrial sectors and from an academic perspective (I.e. Case study, surveys and interviews) as opposed to theoretical and conceptual papers that have limited relation to implementation.

METHODOLOGY

The initial stage of the methodology has been designed to cluster the main themes into groups according to the frequency and co-occurrence of keywords. The first stage is further subdivided into: data collection, pre-processing and the text and data mining (TDM) stage. This was followed by the systematic literature review of each cluster to address the second research objective. Text mining and natural language processing (NLP) specifically is used increasingly by academics to highlight the main themes from a large set of structured and unstructured textual data apparent in developing fields such as I 4.0, therefore the TDM method has been prioritized for the current systematic literature reviews. Moreover, due to ease of access only the summary or abstract of journal articles was included in prior research into I 4.0 using similar methodology. Consequently, this research aims to go beyond the data included in the abstract and analyse the full-text files to provide a more comprehensive representation of extant topics.

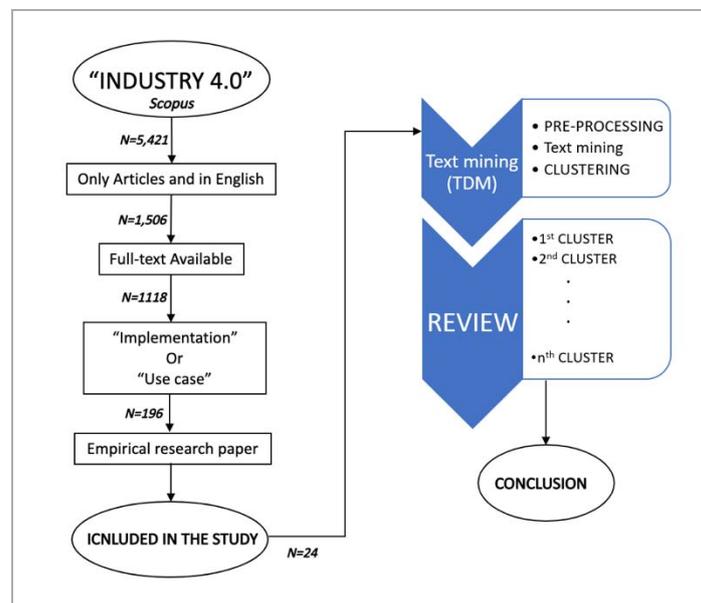


Figure 1: Methodology Flow Chart

Prior to the analysis of the selected documents using text and data mining (TDM), the pool of papers is subjected to a set of selection criteria. To minimize subjective selection, the papers are narrowed down to the final corpus through three progressive stages of data collection, pre-processing and the text mining operations, and eventually the clustering of the results into themes as shown in figure 1.

Data collection

The current research employs content analysis of a set of academic papers from the corpus database prior to the systematic review of individual themes. To capture the full spectrum of data contained in academic papers relating to the implementation of I 4.0 all the articles with the keyword "Industry 4.0" mentioned in the title, keywords or abstracts of the paper have been selected, totalling 5421 articles as of July 2019. In order to further narrow down the search, only journal articles written in the English language have been selected, providing 1506 results. Consequently, a secondary search has been conducted to select the papers that include the keyword "Implementation" in the title, abstract or keywords (n=544) and those that are available as full-text files (n=196) have been selected for the final screening stage. Furthermore, 116 papers rated three had full compliance with the inclusion criteria and focus on prior empirical studies. In contrast, papers rated one or two were excluded due to their technical focus or lack of relation to implementation.

Pre-processing

The pre-processing stage aims to clean the data presented in the articles to reveal the relevant textual data for the next stage of the TDM. For the purposes of this research the figures and images as well as the data contained within brackets "()" and braces "{}" have been removed as this presents irrelevant or duplicate data. Furthermore, in order to consider similar words such as "Industry 4.0" and "Industrie 4.0" under the same meaning, a Lemmatization method has been use

Text and data mining: After the pre-processing stage the set of articles is uploaded into QDA miner add-on software called Wordstat for full text analysis. In order to clarify the existing clusters within the corpus, the keywords illustrated in the frequency analysis (limited to 100 results) shown in the example below is reviewed to remove partial word segments (I.e. AGRI) and separate those from acronyms such as IoT and OPC. This has been accomplished by examining the key word-in-context for every term which shows the list of case segments (article chapters) from which the term has been extracted. Furthermore, the term frequency-inverse document frequency (TF*IDF) of every keyword is reviewed to separate keywords with high frequency yet low case occurrence. The clustering of the cases is accomplished through initial thematic clustering of the TDM results and correlation of keywords with the original articles.

Literature review: From the pool of 118 articles included in the TDM, 24 papers are selected for the full text review to capture the overall theme. Although adding more papers to the qualitative review would add to the depth of the research, the number or content of the main themes would not change. For the purpose of this research particular attention has been paid to following a coherent article structure, choosing the right balance between breadth and depth, and focusing on concepts (concept-centric) by thematically structuring the review section as opposed to a chronological or alphabetical structure of the extant publications (Fisch and Block, 2018).

RESULT

The following section presents the results of the text mining operation, including a review of the frequency analysis, a dendrogram and link analysis. The TF*IDF represents the importance of a word within the context of the larger corpus. This is of particular importance as I 4.0 remains a novel topic and certain words may be highly frequent in one article but not representative of emerging themes. As shown in table 1, the term “CLOUD” has a frequency of 1236 and the term is used in 68 articles (56.67%) included in the corpus, corresponding to TF*IDF of 304.9. In comparison, the term “JOINT” is mentioned 77 times in 42 cases, representing a TF*IDF of 35.1. The following table shows the 62 keyword results with the highest TF*IDF. The results indicate a focus on the main technologies of I 4.0 such as Cloud, IoT, CPS and robots, representing the enabling factors of I 4.0, with TF*IDF of 304.9, 179.7, 152.9, and 311.7 respectively. Nonetheless, the high frequency and case occurrence of other keywords such as Lean and assembly tends to reveal the importance of comprehending the current state of the industry. In other words, the frequency analysis illustrates that there is a link between the current state of the industry and the requirements of I 4.0 transformation.

The inter thematic link is further exemplified by the link analysis of the social related terms and the apparent connection of the terms “Experience”, “Consumer”, and “Customer” with operational terms such as IoT and Computing. Furthermore, excluding isolated terms such as “EU”, which only has a case occurrence of 32.50%, reveals the connection of the remaining keywords. In addition to the technology related cluster, which includes the above-mentioned terms as well as “sensor”, “Maintenance”, and “Equipment” there is a cluster related to the operational aspects of smart manufacturing, which seems to be more common than other themes, as shown in figure 4. Nonetheless, based on figure 2, the inclusion of strategy related terms such as “Lean”, “Digitization” and “Interaction” illustrates a second theme related to the strategic management of firms. Lastly, according to figure 3 the occurrence of social related terms such as “Consumer”, “Customer”, “Experience”, “Engineer”, and “Competitiveness” reveals a third cluster related to the social implications of I 4.0 implementation as both the high frequency and case occurrence implies the increasing importance of social topics in the extant literature within the corpus. Moreover, figure 6 illustrates the strong link of social terms with operational themes (e.g. Assembly & Maintenance) as well as strategic themes (e.g. Lean).

Table 1: Keyword Statistics

Keyword	FREQUENCY	% CASES	TF * IDF	Keyword	FREQUENCY	% CASES	TF * IDF
ROBOT	1114	52.50%	311.7	PRODUCTIVITY	274	53.33%	74.8
ASSEMBLY	797	40.83%	310.0	DETECTION	134	28.33%	73.4
CLOUD	1236	56.67%	304.9	INTERACTION	276	55.00%	71.7
LEAN	549	40.83%	213.6	ADAPTATION	131	28.33%	71.7
EQUIPMENT	688	53.33%	187.8	FAILURE	189	42.50%	70.2
ARTIFICIAL	386	34.17%	180.0	COMPETITIVENESS	129	30.00%	67.5
IOT	856	61.67%	179.7	MANUFACTURE	155	37.50%	66.0
FACTORY	1341	76.67%	154.7	REDUCTION	187	45.00%	64.8
DIGITIZATION	286	29.17%	153.0	ROBOTICS	154	40.83%	59.9
CPS	508	50.00%	152.9	CONNECTIVITY	109	28.33%	59.7
CONSUMERS	552	56.67%	136.2	ADAPTIVE	168	44.17%	59.6
SERVERS	237	30.00%	123.9	ELECTRICAL	140	37.50%	59.6
MODULE	276	35.83%	123.0	ENGINEERING	1104	88.33%	59.5
SIMULATION	421	51.67%	120.7	DEPLOYMENT	115	30.83%	58.8
MANUF	301	40.00%	119.8	EU	120	32.50%	58.6
CUSTOMER	368	47.50%	119.0	STORAGE	168	45.83%	56.9
HTTPS	633	66.67%	111.5	MECHANICAL	234	57.50%	56.2

SENSOR	353	49.17%	108.8
MAINTENANCE	652	68.33%	107.8
SCHEDULE	312	46.67%	103.3
PLANT	281	43.33%	102.1
MANUAL	254	40.00%	101.1
REVOLUTION	379	54.17%	100.9
COMPUTING	535	65.00%	100.1
AUTONOMOUS	196	33.33%	93.5
CYBER	740	75.00%	92.5
EXPERIENCE	362	55.83%	91.6
SAFETY	254	45.00%	91.6
CONSUMPTION	176	31.67%	87.9
MULTI	293	55.00%	76.1

PROTOCOL	199	35.00%	54.3
ENGINEER	199	35.00%	54.4
AUTOMATIC	116	37.50%	49.4
CONTROLLER	92	29.17%	49.2
DEPLOY	101	33.33%	48.2
REMOTE	92	30.00%	48.1
TECH	217	60.83%	46.8
MATION	100	34.17%	46.6
EQUIP	83	34.17%	38.7
ENVIRON	72	29.17%	38.5
EXPECTATION	73	30.83%	37.3
JOINT	77	35.00%	35.1
REVISE	39	30.83%	19.9

It is important to note, however, that most terms relate to more than one theme. As illustrated in figure 5, “Lean” may be related to the lean management practices at the management level as well as lean practices at the factory floor. The multilevel connection of operational practices is also illustrated in the dendrogram (Figure 5) as the operational, strategic (i.e. OEE) and social terms (i.e. HRC, Safety) are interlinked. Similarly, the term “Connectivity” may refer to the connectivity of machines as the link to the term “Electrical” in the dendrogram reveals, or it may refer to the connectivity of consumers or the workforce; however, the latter may be more related to the term “Interaction”, as more links are observable.

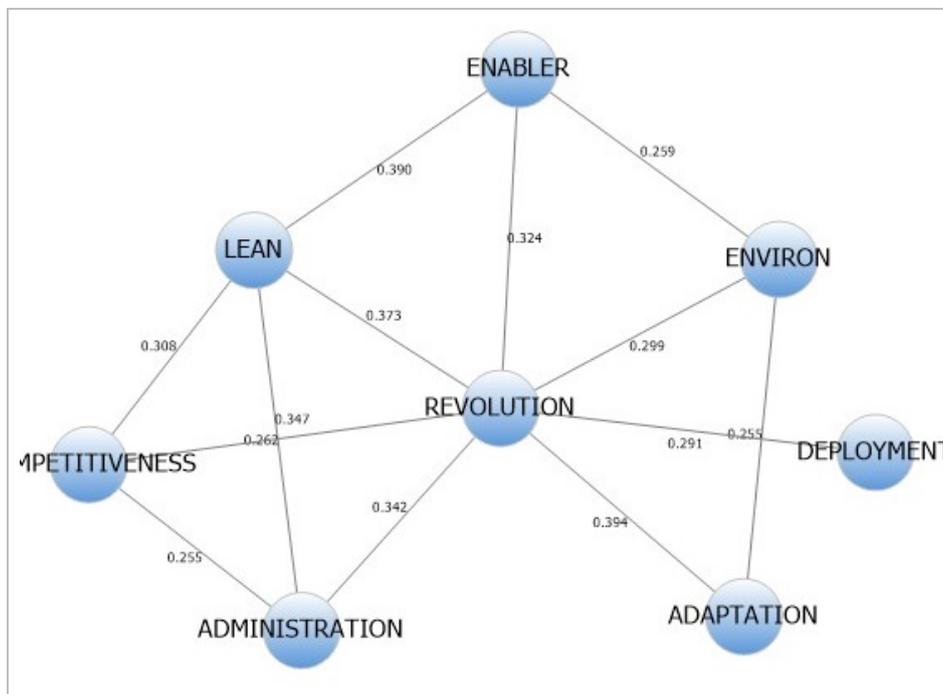


Figure 2: Strategic Link Analysis

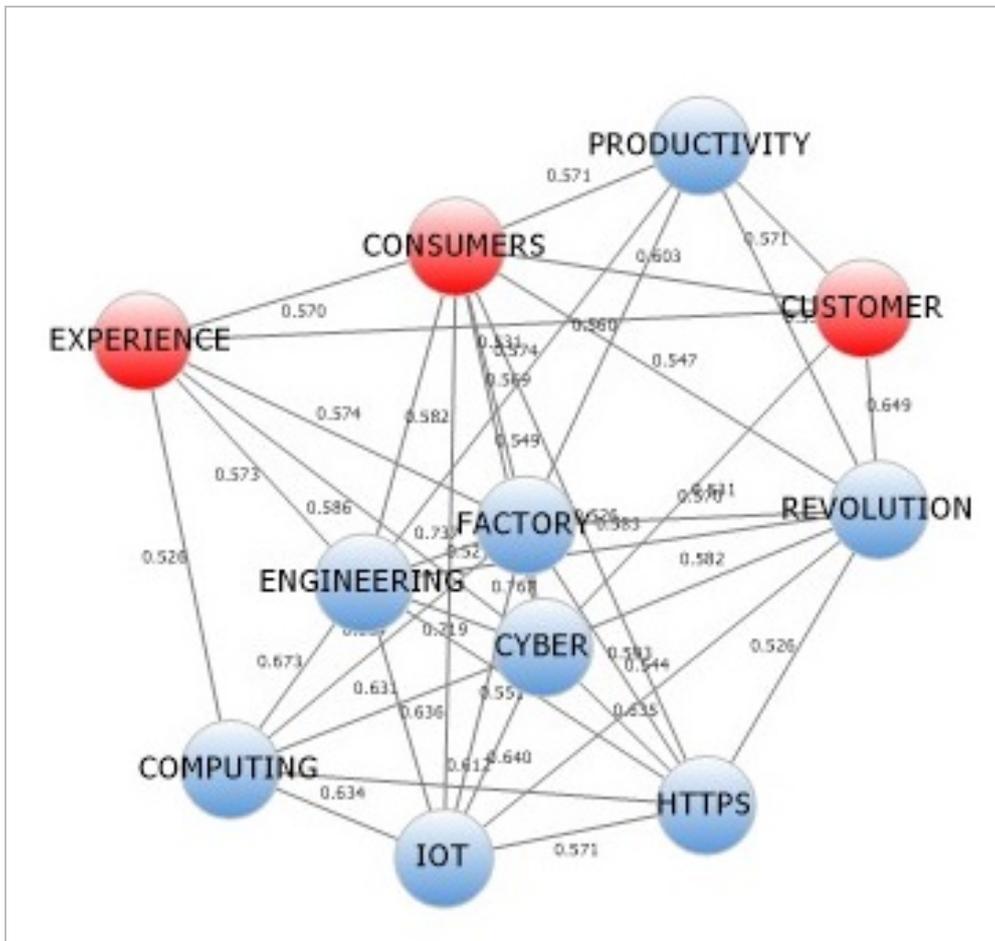


Figure 3: Social Link Analysis

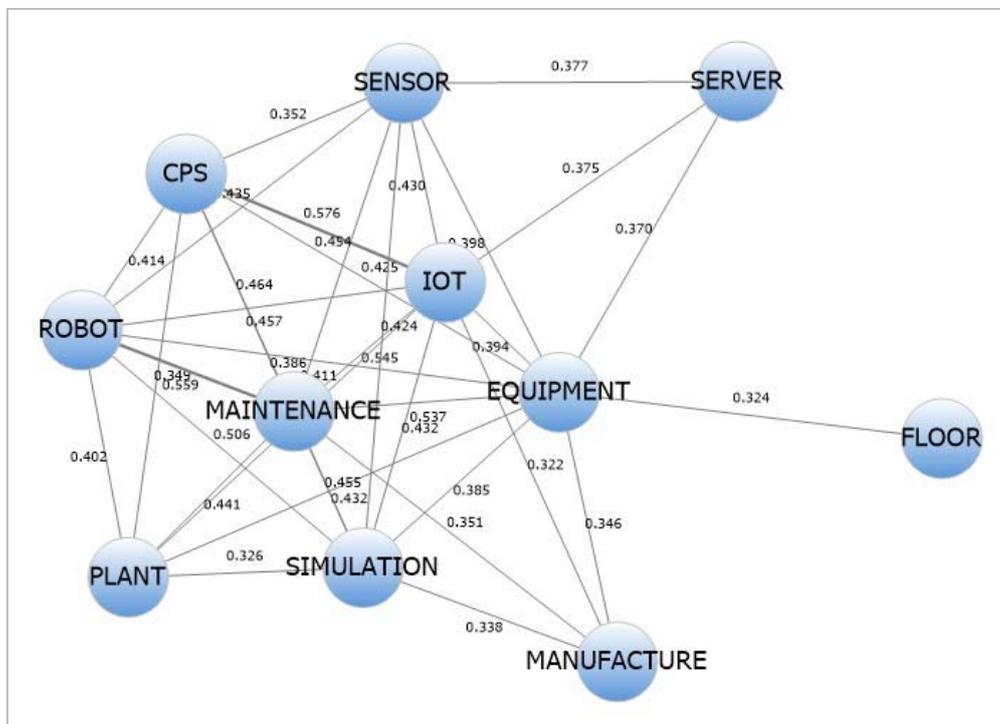


Figure 4: Operational Link Analysis

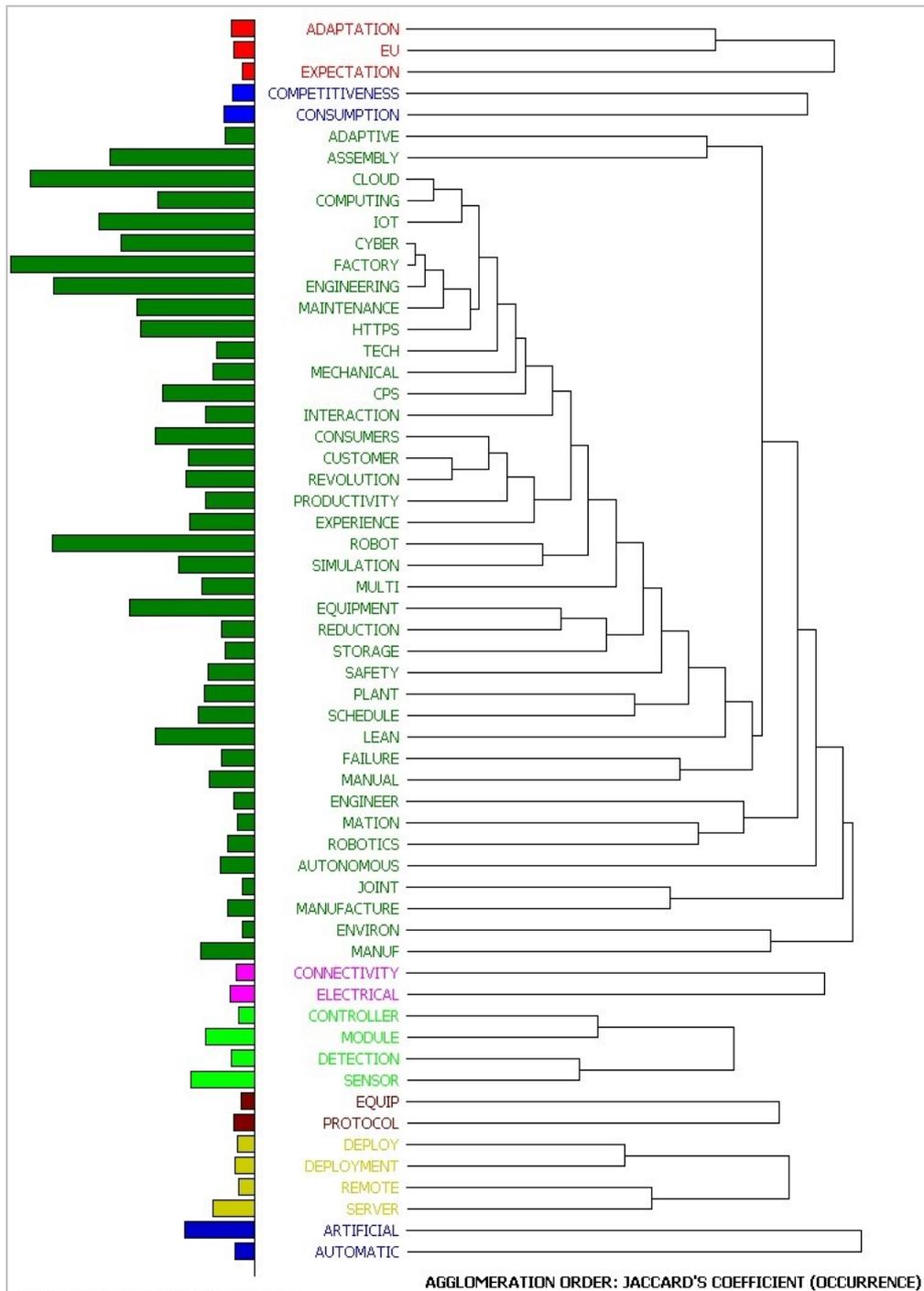


Figure 5: Dendrogram

In general, the most prevalent them in the present study is the operational theme, which represents the technologies and methods employed at the factory level, followed by strategic management and social implications. Furthermore, given the formation of clusters apparent in the frequency list and the link analysis and the interconnectivity of the underlying themes, it is necessary to review each theme in more detail by qualitative analysis of each case to determine the state of the literature and reveal gaps.

The final stage of the text mining relates the keyword clusters back to the cases (Articles) from which they predominantly originate. Due to limitations of space, an example of the three clusters and the corresponding cases is shown in table 2. In total, out of 116 cases included in the study, 48 are related to operational aspects, 50 are related to management strategy, and 18 are related to the social implications of I 4.0 implementation.

Table 2: Case clustering

	<u>TERM EXAMPLE</u>	<u>CASE EXAMPLE</u>
Social Cluster	<p>“Competitiveness”</p> <p>“Experience”</p> <p>“Safety”</p> <p>“Interaction”</p> <p>“Customer”</p> <p>“Consumer”</p>	<p>Gorecky (2017), Introduction and establishment of virtual training in the factory of the future</p> <p>Dukalski et al (2017), Portable Rapid Visual Workflow Simulation Tool for Human Robot Coproduction</p> <p>Li et al (2018), Research on Dynamic Facility Layout Problem of Manufacturing Unit Considering Human Factors</p> <p>Antosz (2018), Maintenance - Identification and analysis of the competency gap</p>
Operational Cluster	<p>“Robot”</p> <p>“Assembly”</p> <p>“Cloud”</p> <p>“Equipment”</p> <p>“CPS”</p> <p>“IoT”</p>	<p>Larrinaga et al (2019), A Big Data implementation of the MANTIS reference architecture for predictive maintenance</p> <p>Lee et al (2019), A blockchain enabled Cyber-Physical System architecture for Industry 4.0 manufacturing systems</p> <p>Lee et al (2015), A Cyber-Physical Systems architecture for Industry 4.0-based manufacturing systems</p> <p>Yue et al (2015), Cloud-assisted industrial cyber-physical systems: An insight</p> <p>Yoon et al (2019), Smart Factory Information Service Bus (SIBUS) for manufacturing application: requirement, architecture and implementation</p> <p>Wan et al (2017), A Manufacturing Big Data Solution for Active Preventive Maintenance</p>
Management Cluster	<p>“Lean”</p> <p>“Digitization”</p> <p>“Revolution”</p> <p>“Productivity”</p>	<p>Müller (2019), Business model innovation in small- and medium-sized enterprises: Strategies for industry 4.0 providers and users</p> <p>Ante et al (2018), Developing a key performance indicators tree for lean and smart production systems</p> <p>Bär et al (2018), Considering Industry 4.0 aspects in the supply chain for an SME</p> <p>Prause (2015), Sustainable business models and structures for industry 4.0</p> <p>Mueller (2017), Challenges and Requirements for the Application of Industry 4.0: A Special Insight with the Usage of Cyber-Physical System</p>

DISCUSSION

As briefly examined in section 1.1, the fourth industrial revolution and I 4.0 specifically, is an ongoing paradigm that is taking shape and that is gradually evolving depending on the decision making of involved stakeholders at multiple levels and stages. Although industrial strategies at the national and regional level constitute an underlying policy and legal framework for I 4.0 adaptation, the main drivers of change and sources of innovation remain at the factory and individual levels. On the other hand, Morrar, Arman and Mousa (2017) look at the global effects of I 4.0 from a social innovation perspective and argue that the global society should benefit from the forthcoming industrial revolution as consumers and producers are becoming more connected. This multifaceted nature of I 4.0 implementation potentially maximises the benefit to early adapters, but as a multidisciplinary approach is required, research can be slowed down by isolated studies that may not initially reveal a link. Therefore, the following section provides a thematic map of recent developments within the academic literature on I 4.0 adaptation based on the results of the TDM and qualitative analysis of the selected articles.

Multi-layered Approach to Implementation

Scholarly articles elaborating the regional complexities of I 4.0 are also scarce but compared to the global level (Macro-level), more authors are involved. Santos et al (2017) study the European strategy for I 4.0 implementation. The authors state that implementation across multiple nations within a region requires the collaboration of stakeholders in the form of forums such as the European technology platforms (ETPs), the European factories of the future association (EFFRA) and public-private partnerships (PPP). Ciffolilli and Muscio (2018) further analyse the implications of implementation within Europe by conducting an empirical study on the investment towards I 4.0 within regions of member counties. The study finds that in contrast to EU policy on I 4.0 implementation (Santos et al, 2017) the flow of investments is only directed towards “I 4.0 hubs”, resulting in a lack of funding and modernization in many regions, impeding the regional implementation of I 4.0 initiatives. Moreover, Castelo-Branco, Cruz-Jesus, and Oliveira (2019) provide a study on the implementation strategies and methods of the European manufacturing sector and reiterate that regions show large disparities in the level of implementation. Nonetheless, the authors argue that regions that are not considered as hubs can be involved and connected through the development of a unified digital infrastructure, such as the single digital market (SDM) and the promotion of analytical capabilities to deal with and interpret the volume of data generated. Table 3 illustrates examples of the main articles associated with the national level implementation as well as the findings.

Due to the vast amount of resources required for change, the social and strategic implications of adaptation have not been comprehensively studied within the context of developing or underdeveloped nations. Schneider (2018) states that as opposed to industrial nations, developing nations are likely to experience the “brownfield scenario”, in which existing processes and infrastructure cannot be replaced, and investment is justified by gradual upgrades of current technology.

Table 3: Regional development

Author(s)	Country	Findings / Gaps
Zhou, Liu and Zhou, 2015; Müller, Kiel and Voigt, 2018; Wilkesmann, 2016	Germany	I 4.0 will increase productivity by 30%. Social, operational and strategic opportunities drive the implementation of I 4.0 but risks of competition and future viability impede implementation. Implementation strategy strongly depends on the company size, location and culture. More international studies are required to facilitate optimization and standardization.
Sung, 2018; Park, 2016	Korea	Lack of adequate skill set, reluctance of stakeholders to change, loss of low and medium skilled jobs due to automation. Standardization of core technologies is needed. Further collaboration between government and private sector is recommended.
Li, 2018; Zhou, Zhou and Liu, 2015	China	More work is needed on the managerial implications at the firm level and with regard to inter and intra company collaborative scientific activities. The discrepancy between societal and industrial impact needs to be further studied.

Thematic Development

In order to further analyse the requirements and prerequisites of I 4.0 implementation, it is necessary to subdivide the various implementation approaches cited within the relevant literature to clarify the main themes and constituent parts. The division of academic studies provided by Schneider (2018) as elaborated in the previous section is further subdivided into three subcategories: (a) technical elements of operation (e.g. cybersecurity, new product development), which is the focus of engineers across multiple research fields, (b) novel strategic management approaches to traditional business operations (e.g. supply chain management, marketing and business model innovation), and (c) the social aspects (e.g. human resource management, training, mental and physical safety), which involves workers, managers, customers and consumers (Müller, Kiel and Voigt, 2018). This classification falls in line with the distinctions of Galati and Bigliardi (2019) and Stremersch and Van Dyck (2009), but the classification of the latter authors is further subdivided into six and four classifications respectively. Zhou, Liu and Zhou (2015) provide an alternative factory-level strategy for implementation, which is more inclined to the German implementation strategy. The strategic plan can be summarized as building a network, researching two major themes, realization of three integrations and achieving eight planning objectives. The plan culminates in building a network of connected devices and people in the form of cyber physical systems (CPS) to facilitate and elevate the capabilities of computing, communicating, precision control, coordination, and autonomy within the manufacturing environment. The two main themes prioritized for research include: the “Smart factory”, which focuses on the underlying systems and processes within and across network connected production facilities, and “intelligent production”, which takes into account the human-computer interactions, the management and logistics and the required physical and virtual technologies.

Ultimately the implementation strategy initially proposed by Conti et al (2017) and further elaborated by Zhou, Liu and Zhou (2015) aims to achieve the following eight objectives: (1) the standardization of systems and the conception of a reference architecture, (2) efficient management, (3) the establishment of a comprehensive industrial broadband infrastructure, (4) safety and security, (5) the organization of design work, (6) staff training and continuing professional development, (7) establishing a regulatory framework, and (8) improving the efficiency of resource use. Establishing a sustainable digital strategy or plan at the firm level exposes hidden and unknown barriers to implementation and clarifies the path for digitalization.

Strategic implementation

The strategic management of business operations at various management levels (i.e top management, HRM, Operations management, SCM, CRM etc.) remains at the core of the digital transformation of a company and strongly influences the operational and social implementation of I 4.0 practices (Schneider, 2018). The company's business model (BM) defines and clarifies the plan and objectives for internal stakeholders as well as potential investors. Nonetheless, increasing competition, the changing global markets (Globalization) and increasing market volatility necessitates the continuous change of BM's and the introduction of a digital transformation strategy by many firms (Lasi et al, 2014). With regard to the initial stages of the business model shift towards a digital strategy, a study on the business model innovation of SME's examines a set of 43 expert interviews with German manufacturing sectors such as automotive suppliers, electrical, mechanical and plant engineering, Müller (2019). The author acknowledges the limited scholarly focus on the management aspects (particularly business models) of implementation as opposed to the economic and technical aspects of implementation, reinforcing the findings of other authors such as Arnold et al (2016), who examine the impact of IoT on business model innovation across multiple sectors, and Loebbecke and Picot (2015), who examine business model transformation as a result of big data analysis (BDA). According to Müller (2019), "technologically triggered business model innovation" constitutes the backbone of digital transformation. Beyond the prior literature on business model innovation, the project management aspects are of paramount importance to the successful implementation of I 4.0 for a given firm. Traditional project management practices aim to introduce consistency, flexibility and efficiency at the enterprise level or the underlying departments and consist of process description, work breakdown structure, life cycles, roles and responsibilities and templates in addition to total quality management (TQM) as elaborated by the project management institute (PMI) according to ISO 9001 standards (Martínez-Costa et al, 2009). Jovanović et al (2015) elaborate on the difference between lean manufacturing and agile manufacturing and argue that, as opposed to traditional project management approaches, the agile management approach involves a creative and innovative approach due to unclear project requirements and an iterative project plan.

Operational implementation

An increasing number of scholars are studying the operational aspects of I 4.0 and proponents of operational change argue that there is a direct correlation between the expected load balancing such as production optimization (Ding, Jiang and Zheng, 2017; Weinert, Chiotellis, and Seliger, 2011) and waste reduction and therefore a reduction in greenhouse gas emission (Peukert et al, 2015). Various I 4.0 technology providers have presented digital platforms for I 4.0 users. Chen (2017) provides a study on the enabling technologies, including CPS, Industrial internet, Machine learning, Cloud computing, and Big data analytics. The author further examines digital platforms based on the aforementioned technologies provided by: General Electric, providing Predix edge, Predix cloud and Predix machines for data collection and BDA, Siemens, providing factory floor technologies and digital twin model software platforms, and PTC ThingWorx, providing IIoT platforms. The author agrees that digital platforms provided by technology companies in conjunction with governmental support shows the most promising potential for implementation from a I 4.0 user perspective. Alternative studies on the operational aspects of I 4.0 within the manufacturing sector examine the production planning and control. Tsai and Lu (2018) analyse a tire making factory under I 4.0 and argue that traditional cost systems are diminishing in favour of activity-based costing (ABC). At the operational level ABC uses resource drivers and activity drivers at four levels, namely, Unit-level activities (I.e. 100% inspection), batch-level activities (material handling, set-up, scheduling etc.), product-level activities (product advertising, designing etc.), and facility-level activities. The authors further state that operational activities can be managed based on the shop floor control (SFC), which, according to the authors, "parameterizes the real-time shop floor data for control" by collecting data from the Manufacturing Execution System (MES) among other sources of data.

Social implementation

The strategic and operational aspects of implementation are considered as the initial stages and the backbone for I 4.0 adaptation within the manufacturing sector, though many scholars argue for more research on the social impacts of implementation. Müller (2019) argues that employee resistance and the fear of being replaced or having inadequate digital skills in the upcoming industrial transformation significantly impedes implementation at all stages, adding that existing personnel might become obsolete. This social shift necessitates the need for "creative problem-solvers" in multiple organizational positions (Kiel, Arnold, and Voigt, 2017; Müller, Kiel and Voigt, 2018) and requires the entire workforce to evolve as the digital transformation unfolds (Sjödín et al, 2018). Other authors take an alternative stance and argue that in contrast to the traditional industrial eco-system in which the worker had to adapt to the working environment, in the era of I 4.0 social needs and habits are pushing the industrial transformation (Jovanović et al, 2015).

A quick review of the above subthemes reveals that implementation of I 4.0 is not only dependant on the industry sector or company size, but also on the various levels within a company. This can be a determining factor in the successful transformation of departments and internal sectors, such as Human resources (HR), Logistics/Supply chain, and multiple

management levels. Qualitative analysis of the selected papers illustrates that previous research on this topic is primarily concentrated on what has been identified by Schneider (2018) as a promising research avenue. Therefore, one of the main limitations is the lack of studies on evaluating this transformation. A second limitation is the lack of studies on the implication of human factors in relation to the ever-increasing trend of automation and robotization. Many companies lack a coherent management structure that is based on lean and agile manufacturing either as a result of lack of resources, small size of the company or inadequate returns. This can be further exacerbated by systematic reluctance of top management to change or on the exclusion of involved workers from the decision-making process.

CONCLUSION

Academic management scholars largely agree that the implementation of I 4.0 at the firm level requires a multidisciplinary approach. The present study has compiled recent articles on implementation and conducted a text and data mining (TDM) operation on the selected articles. The results of the TDM and subsequent qualitative analysis of the underlying themes reveals that managerial empirical studies on I 4.0 implementation at the firm level remain scarce yet are highly in demand within the academic and industrial research communities. Capturing valid data from industry and relating the findings to academic studies is considered as a major challenge, which has not only impeded implementation but may result in uneven market digitization and facilitation of I 4.0 monopolies.

Similar to other studies this study is subject to limitations. The current study is limited by the number of articles included in the qualitative review and future work may benefit from including more articles from a broader range of interdisciplinary fields to clarify previously hidden complexities from a managerial lens. Also, given that the geographical focus of the study is general, future academic work on this topic may benefit greatly by focusing on a specific country or industry and provide cross comparison of results across firms in one industry sector or between similar industries in one country.

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Improving Attribute Classification with Imperfect Pairwise Constraints

(Full Paper)

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ABSTRACT

Semantic attributes extracted from images could help to improve many interesting applications, including image classification, recommendation systems and online advertising. However, learning of such attributes requires a large well-labelled dataset which is usually difficult and expensive to collect and sometimes requires human domain experts to annotate. Partially labelled data, on the contrary, are relatively easy to obtain from social media websites or be annotated by less experienced people. However, a partially labelled dataset usually contains a lot of noisy data which are challenging for previous methods. In this paper, we propose a semi-supervised Random Forest algorithm that can handle a small well-labelled attribute dataset and large scale pairwise data at the same time for classifying grouped attributes. Results on two typical attribute datasets show that the proposed method outperforms the state-of-the-art attribute learner.

Keywords: Machine Learning, Pairwise data, Imperfect Data

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INTRODUCTION

Semantic attribute learning attracted a considerable growth of interest from computer vision and multimedia researchers in the last few years. By using those mid-level features, the accuracy of high-level category classifiers could be improved, and the learned attributes can be adopted as semantic features for other multimedia applications. For example, using Computer Vision to recognize and describe fashion items at the semantic level is extremely helpful for analyzing personal fashion styles (Hu et al. 2015). However, the training of a semantic model needs a large set of well-labelled data (Bossard et al. 2012; Di et al. 2013; Hu et al. 2008) and as the fashion items increase every year, there is also a strong demand to update the current model with new data. The previous work mostly generated their datasets with the help of crowdsourcing (Chen et al. 2012; Liu et al. 2012) which is time consuming and expensive. This a need to design attribute learning algorithms that do not require many well-labelled data.

One possible solution is transfer learning (Pan and Yang 2010) or domain adaptation (Ben-David et al. 2010) converting well trained models from a previous well-labelled dataset to the new dataset with limited labelled data. However, the limitation of both transfer learning and domain adaptation lies in that it is required that the well-labelled and new dataset to be related. This requirement is easy to meet when only category level information is considered. In the real scenario, it's very common that the concentration is on the attribute level categorization which are mostly dataset specified (e.g. dressing style in clothes dataset or sociality in animal dataset) and not related. Therefore, we consider another possible solution of using unlabelled and partially labelled data which can be easily obtained from the Internet or quickly annotated by humans. Utilizing both well-labelled and unlabelled/partially labelled data is a typical semi-supervised learning scenario. However, partially labelled data usually contains a lot of noisy information, especially for abstract attributes such as the style of clothing or the design of fashion items.

There are many existing approaches on semi-supervised learning. Some consider it as a clustering problem without taking advantage of the well-labelled data at all (de Amorim 2012; Hu et al. 2008; Wagstaff et al. 2001; Zeng and Cheung 2012; Zhu et al. 2016) and others use a well labelled dataset along with totally unlabelled data (Liu et al. 2013) but ignore the weak relationship in the unlabelled data. A most related solution to our work was presented by Nguyen and Caruana (2008) and Yan et al. (2006) who used a well labelled dataset together with additional partially labelled data, but their methods do not work well with noisy data.

This paper aims to provide a solution to solve the problem of learning attributes from partially labelled noisy data together with well-labelled data. The contribution of our work is two-fold. Firstly, our model is built on a small set of well-labelled training data with a large amount of noisy pairwise constraint data. Secondly, the pairwise data is collected according to semantic groups (e.g. color or texture) and only two pairwise constraints (i.e. must-link, meaning a pair of samples must be in the same class, and cannot-link, meaning a pair of samples must come from different classes) are applied. The objective is to utilize such pairwise data to prove semantic attribute learning.

LITERATURE REVIEW

We review the related works in two aspects, semantic attribute analysis and semi-supervised learning.

Semantic Attribute Analysis

Attribute learning as a specific image classification problem has gained lots of interest and resulted in many successful applications (Bossard et al. 2012; Chen et al. 2012; Di et al. 2013; Liu et al. 2012). Such approaches usually use low-level features to train many mid-level classifiers, and then the mid-level attribute information can be used to generate a more accurate high-level classifier or to analyze the semantic information of images. However, the training of mid-level classifiers relies on well-labelled data that are hard and expensive to collect. Furthermore, the selected attributes are mostly simple ones such as color or texture which do not contain much expert domain knowledge. Thus, the use of partially labelled data rather than well-label data makes the previous work more realistic.

Semi-supervised Learning With Pairwise Constraints

Semi-supervised learning is a class of machine learning techniques that makes use of unlabelled or partially labelled data for training. In this paper, we specify the partially labelled dataset as pairwise constraint data and analyze the existing work, which can handle pairwise constraint relations.

To utilize pairwise constraints, some researchers consider it as a clustering problem and develop constrained clustering algorithms based on K-means such as COP K-means (Wagstaff et al., 2001) and CMWK-Means (de Amorim, 2012). With a similar idea, a more efficient Semi-supervised Maximum Margin Clustering method was also introduced to handle the pairwise constraints (Zeng & Cheung, 2012; Hu et al., 2008). The drawback of these algorithms is that they make a strong assumption that the pairwise constraint data are accurate. However, in practice, pairwise information is usually collected from social media sites that makes it contain many noisy data. To avoid the influence of noisy data, the Constraint Propagation Random Forest which attempts to prevent the noise impact by an ensemble is formulated (Zhu et al., 2015). Compared to the previous algorithms, it performs better when dealing with noisy data. However, the limitation of these algorithms is that they only use the pairwise constraint data to do clustering rather than classification. To build attribute classifiers, a small set of well-labelled data should be utilized along with a large amount of pairwise data.

Taking labelled data into consideration, Liu et al. (2013) proposed a Random Forest based approach which trains trees with both labelled and unlabelled data, and as an ensemble method it is also robust for noisy data. However, this algorithm does not take the relation among unlabelled data into consideration, but only uses them as background knowledge to find better splits. To use labelled data and pairwise information at the same time, Convex Pairwise Kernel Logistic Regression which builds a loss function with pairwise constraint information was introduced by Yan et al. (2006). Similar with this work, a Margin-based approach was also proposed (Nguyen and Caruana 2008). In this method, a regular multi-class SVM is extended with a pairwise optimization objective function. These two algorithms use both well-labelled and partially labelled data, but according to our experiments, they are not robust to noisy pairwise data and do not consider the different qualities between well-labelled data and pairwise data. In addition, based on Spectral Kernel Learning, Shang et al. (2012) proposed a semi-supervised classification algorithm with enhanced spectral kernel under the squared loss (ESKS) which also takes labelled data and pairwise labelled data into consideration. However, the target dataset of ESKS is with large labelled data and small number of unlabelled or partially labelled data. That is different with the situation we considered in our work which the dataset contains small number of labelled data and large number of partially labelled data.

ROBUST RANDOM FOREST WITH PAIRWISE CONSTRAINTS

A fully supervised dataset usually includes a set of labelled training samples $L = \{x_i \in X \mid i=1 \dots l\}$ and their labels $\{y_i \in Y \mid i=1 \dots l\}$ where $X \subset \mathbb{R}^d$ is the feature space, $Y = \{1 \dots k\}$ (Chen et al. 2012) is the label set and l is the number of samples. In this paper, in addition to the labelled data, there are also partially labelled data, which include Must-Link $M = \{(x_i^\alpha, X_i^\beta) \mid y_i^\alpha = y_i^\beta\}_{i=1 \dots m}$ and Cannot-Link $C = \{(x_i^\alpha, X_i^\beta) \mid y_i^\alpha \neq y_i^\beta\}_{i=1 \dots n}$. In our learning framework, we consider a more realistic situation where the partially labelled data containing many noisy information, which is different from the previous work proposed by Nguyen & Caruana (2008). The labelled dataset, on the other hand, is assumed the well-constructed one with fewer noisy data.

Random Forest With Supervised Learning

Random Forest is a widely accepted ensemble method to handle noisy data (Breiman 2001). It consists of a list of decision trees $\{t_1, t_2, \dots, t_N\}$ independently trained by a random subset of the whole data and the results are generated by getting votes from all trees. Growing each decision tree involves data selection, node splitting and stopping criterion detection. According to a

predefined sub-sample rate \bar{r} , the data selection phase is to randomly select a subset from the whole dataset (Ho 1998). Feeding the selected data into decision trees, each node splits the data into two parts with a splitting strategy. Considering both accuracy and efficiency, the Linear Combination Splits (Geurts et al. 2006) is used more frequently. The function is defined as

$$h(W, \theta) = \begin{cases} 0, & W \cdot x < \theta \\ 1, & otherwise \end{cases} \quad (1)$$

where W is the parameter with one or more non-zero elements to select features, and θ is the split threshold. According to the output of $h(W, \theta)$, all arriving samples are split into either the left or right child node. To find the optimal split parameter, the criterion ΔG is introduced and formulated as

$$\Delta G(R) = G(R) - \frac{R_l}{R} G(R_l) - \frac{R_r}{R} G(R_r) \quad (2)$$

where R refers to the current node, R_l , R_r represent the attempted split to left and right child nodes. The function G can be computed by many methods such as information gain and Gini impurity (Breiman 1984). In this paper, we choose Gini impurity $\sum_{i \neq j} p_i p_j$ due to its efficiency. The p in Gini impurity reflects the proportion of samples belonging to the same category, and it can be calculated as:

$$p_i = \frac{1}{|R|} \sum_{i=1}^{|R|} [y_i = 1] \quad (3)$$

where $|R|$ is the number of samples in current node R and $[y_i = 1]$ refers to indicator function, it equals to 1 when $y_i = 1$ and otherwise equals to 0. The target of information gain is to maximize ΔG by selecting different W and θ . To make it more efficient, maximum attempting number m_{trv} is defined as a stopping criterion. After training, each tree in Random Forest gives a probability estimation of class \bar{l} , $p_i(l|x)$ for a given test case x and the total probability of random forest is calculated by averaging

$$p(l|x) = \frac{1}{N} \sum_{i=1}^N p_i(l|x) \quad (4)$$

where N is the number of trees and $p_i(l|x)$ is obtained by calculating the ratio of class \bar{l} getting votes from the leaves in the i th tree. The result of Random Forest is defined as

$$\hat{l} = \underset{l \in Y}{\operatorname{argmax}} p(l|x) \quad (5)$$

Node Splitting With Pairwise Constraints

The conventional Random Forest described above only takes labelled data as input and the limited size of supervised data in our problem would lead to an obvious performance drop (Liu et al. 2013). To avoid this problem, we extend the current splitting strategy to take pairwise constraint data into training. According to equation 2, the target of split is to maximum the Gini impurity at each node that requires to obtain the proportion of well labelled data belonging to the same category. However, for partially labelled data, samples come in pairs, so when the Must-link or Cannot-link relation is broken by splitting, the gini index calculated by $\sum_{i \neq j} p_i p_j$ does not work. In this situation, we introduce a new method for both Must-link M pairs and Cannot-link C pairs.

Equation 6 obtains the number of samples in Must-link set M falling into the same node, and Equation 7 calculates the total number of samples from Must-link set M in the node R .

$$N^M(R) = 2 * |\{(x^\alpha, x^\beta) | x^\alpha \in R \wedge x^\beta \in R \wedge (x^\alpha, x^\beta) \in M\}| \quad (6)$$

$$N_{total}^M(R) = |\{x^\alpha | x^\alpha \in R \wedge (x^\alpha, x^\beta) \in M\}| + |\{x^\beta | x^\beta \in R \wedge (x^\alpha, x^\beta) \in M\}| \quad (7)$$

where R denotes the current tree node. Like Must-link, we obtain the same data from Cannot-link set C with Equation 8 and 9

$$N^C(R) = 2 * |\{(x^\alpha, x^\beta) | x^\alpha \in R \wedge x^\beta \in R \wedge (x^\alpha, x^\beta) \in C\}| \quad (8)$$

$$\overline{N_{total}^C(R)} = |\{x^\alpha | x^\alpha \in R \wedge (x^\alpha, x^\beta) \in C\}| + |\{x^\beta | x^\beta \in R \wedge (x^\alpha, x^\beta) \in C\}| \quad (9)$$

Based on N and $\overline{N_{total}}$ defined above, we propose two estimation functions as follows:

$$\overline{E^M} = -\log \frac{N^M(R)}{\overline{N_{total}^M(R)}} \quad (10)$$

$$\overline{E^C} = -\log \frac{N_{total}^C(R) - N^C(R)}{\overline{N_{total}^C(R)}} \quad (11)$$

Equations 10 and 11 are the estimation functions for Must-link and Cannot-link sets respectively. These two equations are constructed by the ratio between successful splitting number and total samples. In addition to making it more robust for noisy data, we apply log function to it, which makes derivative of it smaller when the successful number is close to the total number.

According to Equation 2, we can propose a similar split criterion for pairwise constraint data evaluating the tree before and after splitting.

$$\overline{\Delta E(R)} = E^M(R) - \frac{R_l^M}{R^M} E^M(R_l^M) - \frac{R_r^M}{R^M} E^M(R_r^M) + E^C(R) - \frac{R_l^C}{R^C} E^C(R_l^C) - \frac{R_r^C}{R^C} E^C(R_r^C) \quad (12)$$

The new target becomes to find a split to maximize Equation 12.

In addition, our algorithm considers a more complex condition that the pairwise data include a lot of noise information, when the procedure of tree construction closes to the leaf nodes, the total number of pairwise data $\overline{N_{total}^M(R)}$ and $\overline{N_{total}^C(R)}$ could be smaller and Equation 10 and 11 would too sensitive to noise data. In order to avoid this problem, we introduce a combined split strategy as follows:

$$\overline{\Delta C(R)} = \begin{cases} \Delta G(R) + \alpha \Delta E(R), & |L| < |M| + |N| \\ \Delta G(R), & \text{otherwise} \end{cases} \quad (13)$$

Where $|L|$, $|M|$, $|N|$ refers to the number of well-labelled, must-link and cannot-link data respectively, and α is the learning rate for pairwise data. In practice, we usually choose a small number for α which makes $\overline{\Delta E(R)}$ only have a limited influence at tree construction.

In this paper, we assume a situation that the size of partially labelled data is much larger than that of the well-labelled data, but the accuracy is on the contrary. To calculate Equation 13 more efficiently, the samples with broken Must-link or satisfied Cannot-link will be removed from child nodes as shown in Equations 14 and 15.

$$\overline{M^{new}(R)} = \{(x^\alpha, x^\beta) | x^\alpha \in R \wedge x^\beta \in R \wedge (x^\alpha, x^\beta) \in M\} \quad (14)$$

$$\overline{C^{new}(R)} = \{(x^\alpha, x^\beta) | x^\alpha \in R \wedge x^\beta \in R \wedge (x^\alpha, x^\beta) \in C\} \quad (15)$$

The tree constructing procedure is shown in Algorithm 1.

Evaluation Of Trees With OOB Error

In our work, we consider partially labelled data containing a lot of noisy information, and the Random Forest, as an ensemble method, reduces the influence of noisy data by aggregating results from the individual trees. However, the splitting strategy described above considers all the data from both labelled and partially labelled datasets, which means the noisy data still have contributions to the result of each tree. Therefore, when the noise rate of partially labelled dataset is large, most of the trees in Random Forest will be affected by the wrong information and the result from Random Forest could be less accurate. Therefore, there need to be an evaluation method to select training samples.

The training of each tree in the Random Forest is independent and only uses a subset of training data. The samples that are not used for training are defined as the Out Of Bag (OOB) data (Breiman 2001) and the error calculated from it is known as an unbiased estimation of the accurate of trees. Therefore, to reduce the influence of noisy data in a partially labelled dataset, each tree is trained on only the labelled data or both labelled and partially labelled data. If the partially labelled dataset will be randomly generated for training new trees. With the help of this method, a subset containing too much noisy data will be ignored and a new one will be generated. The tree selecting procedure is shown in Algorithm 2.

EXPERIMENTS AND ANALYSIS

To test the performance of Pairwise Constraint Random Forest, we build two different attribute level datasets based on the Clothing with Attributes dataset (Farhadi et al. 2009) and Animal with Attributes dataset (Lampert et al. 2009). Considering the efficiency, the algorithm proposed in this paper is implemented based on the code provided online¹.

Algorithm 1: Construct Random Forest Tree

Input: Well-labelled training data $\overline{X_l} \in L$ in current node R , pairwise data $\overline{(x^\alpha, x^\beta)} \in \{M \cap C\}$ in current node R , learning rate for pairwise data α , maximum splitting attempting number $\overline{m_{try}}$

Output: The best cut hyperplane W and θ , the associated child node $\overline{R_l}$ and $\overline{R_r}$

- 1 Remove unnecessary pairwise training data according to Eq 14 and 15;
- 2 **if** $\overline{\|x_l\|} < (\overline{X^\alpha} + \overline{X^\beta})/2$ **then**
- 3 Set split strategy $\overline{\delta C} = \Delta G(R) + \alpha \Delta E(R)$
- 4 **end**
- 5 **else**
- 6 Set split strategy $\overline{\delta C} = \Delta G(R)$
- 7 **end**
- 8 Initialize W, θ ;
- 9 $\overline{n_{try}} \leftarrow 0$;
- 10 $\overline{\delta C_{best}} \leftarrow 0$;
- 11 **repeat**
- 12 $\overline{n_{try}} = \overline{n_{try}} + 1$
- 13 randomly select W_0 and θ_0 ;
- 14 **calculate** $\overline{\delta C}$ according to selected split strategy;
- 15 **if** $\overline{\delta C_{best}} < \overline{\delta C}$ **then**
- 16 $\overline{\delta C_{best}} \leftarrow \overline{\delta C}$;
- 17 $\overline{W} \leftarrow W_0, \overline{\theta} \leftarrow \theta_0$;
- 18 **end**
- 19 **until** $\overline{n_{try}} > \overline{m_{try}}$;
- 20 **Generate** $\overline{R_l}, \overline{R_r}$ according to W and θ ;
- 21 **return** W, θ , and $\overline{R_l}, \overline{R_r}$;

Dataset settings

Clothing with Attributes Dataset

The Clothing with Attribute dataset includes 11 different attribute groups and totally 36 attributes. According to the learning framework described above, a small labelled dataset and a large pairwise dataset should be generated. To make the pairwise dataset more realistic, we choose 5 major colors as the color group, 6 different patterns as the pattern group, 3 different lengths of sleeve

¹ <https://github.com/karpathy/Random-Forest-Matlab>

and 3 types of neckline shape as another two groups. We only keep 300 well-labelled data and randomly generate pairwise datasets with 800 and 1500 images. To simulate the noisy situation, the four attribute groups are manually added noisy data with 0%, 5%, 10%, 15% and 20% respectively.

Because the Clothing with Attribute dataset only provides the original images, we apply the pose estimation method by Yang and Ramanan (2013) to locate the clothing area. And with the help of VLFeat (Vedaldi and Fulkerson 2010) and scikit-learn (Pedregosa et al. 2011), low level features including SIFT features, Color Histogram features, Local Self-Similarity features and PHOG features are extracted. Then we use PCA to reduce the dimension and keep 99% information.

Algorithm 2: Select Random Forest Tree

Input: Well-labelled training data $\overline{X}_l \in L$, pairwise data $\overline{(x^\alpha, x^\beta)} \in \{M \cap C\}$ maximum training times n
Output: Random Forest Tree T

- 1 $\overline{x}_j^i \leftarrow$ generate a new subset from \overline{X}_l using bootstrap aggregation;
- 2 Training tree \overline{T}_l with \overline{X}_j^i ;
- 3 $\overline{oobe}_l \leftarrow$ Compute the OOB error of \overline{T}_l ;
- 4 $\overline{n}_{try} \leftarrow 0$;
- 5 $\overline{best}_{oobe} \leftarrow \overline{oobe}_l, \overline{best}_T \leftarrow \overline{T}_l$;
- 6 **repeat**
- 7 $\overline{n}_{try} = \overline{n}_{try} + 1$
- 8 $\overline{(X^\alpha, X^\beta)} \leftarrow$ generate a new subset from M and C using bootstrap aggregation;
- 9 Training tree T with both \overline{X}_j^i and $\overline{(X^\alpha, X^\beta)}$;
- 10 $\overline{oobe} \leftarrow$ Compute the OOB error of \overline{T} ;
- 11 **If** $\overline{best}_{oobe} > \overline{oobe}$ **then**
- 12 | $\overline{best}_{oobe} \leftarrow \overline{oobe}, \overline{best}_T \leftarrow \overline{T}$;
- 13 **end**
- 14 **until** $\overline{n}_{try} > n$;
- 15 **return** \overline{best}_T ;

Animal With Attributes Dataset

For the Animals with Attributes dataset, there are totally 85 different attributes in it, in our experiment, we randomly select 5 attributes as the color group, 4 attributes as the texture group, 5 attributes as the living place group and finally 5 attributes as the sociality group. Because this dataset is much bigger and much noisier than the previous one, we select 400 samples as the well-labelled dataset and 1000 and 3000 samples as pairwise data. Then the pairwise dataset is also manually added noisy information at 0%, 5%, 10%, 15%, 20%. As the low-level features are provided by authors (Lampert et al. 2009), we directly use these features and also apply PCA to them and just maintain 99% information.

Reduce The Influence Of Noisy Data

Random Forest uses a subset of training data to build each tree. The sub-sampling rate is the number of samples in a subset divided by that in the whole dataset (Breiman 2001; Liu et al. 2013). In traditional Random Forest, the sub-sampling rate is manually defined before training and the chance of samples to be selected into a subset is equal during training. After the sub-sampling, the data selected by each tree will all contribute to the evaluation for node splitting.

However, in Pairwise Constraints Random Forest, according to Algorithm 1 the pairwise data used in training could be ignored and the influence of them is limited. As we described in Section 3.3, to reduce the influence of noisy data, we evaluate each tree with OOB error and keep generating new subsets from the partially labelled dataset that means the randomly generated subsets containing too many noisy data will be deleted. As a result, even if we fix the sub-sampling rate before training, the chance to choose noisy data into a subset is less than the chance to choose normal data. In the experiment, because the dataset is not balanced, we choose different sub-sampling rates for labelled and unlabelled data as 0.9 and 0.6 respectively. Analyzing the procedure of Pairwise Constraint Random Forest working on both dataset, table 1 shows the average chance of different samples to be selected in all trees during training. The results indicate that the effect of noisy data is reduced by the methods we proposed in this paper.

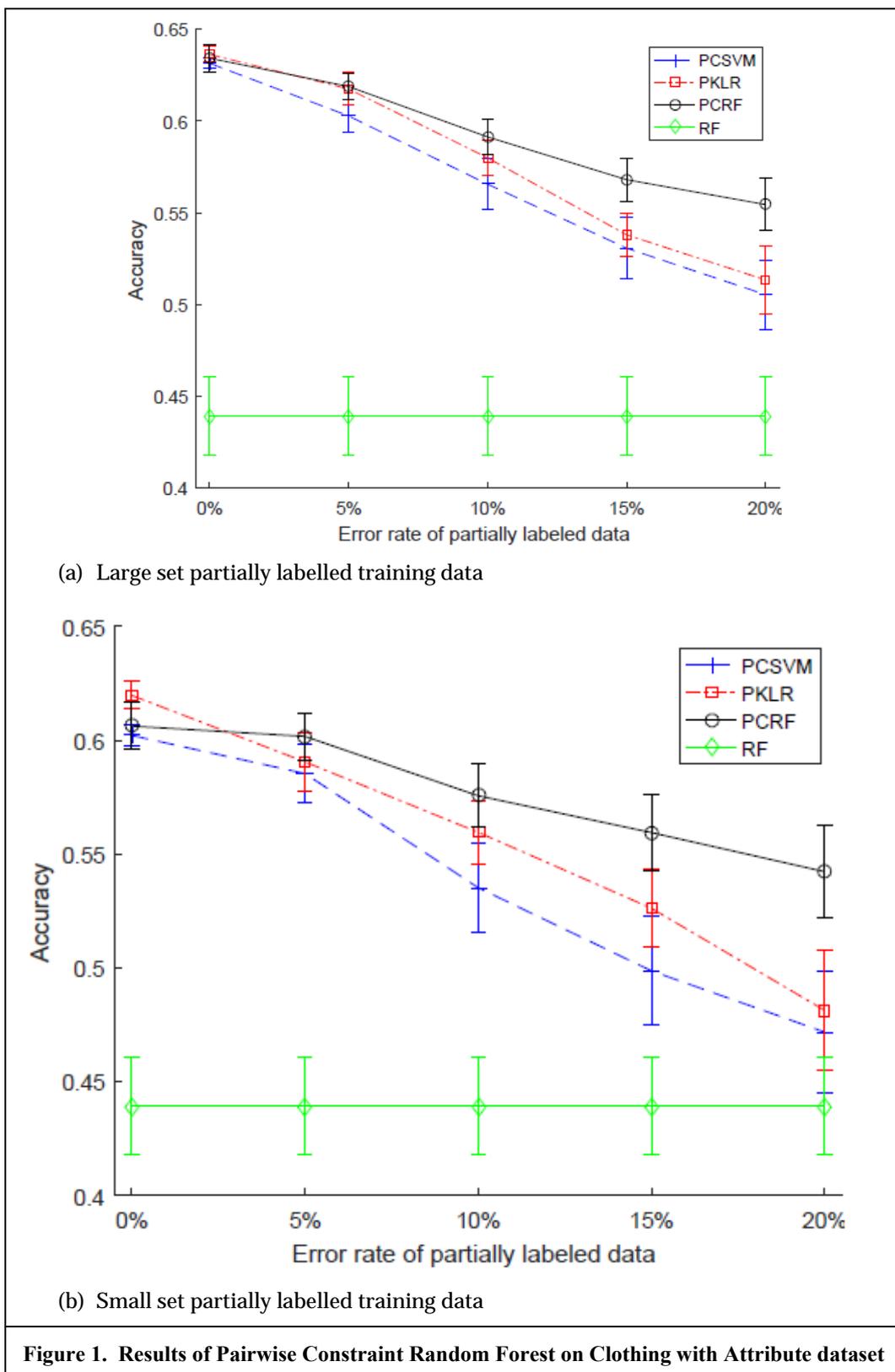
Table 1 Chance of different data to be selected for training					
Noise rate	0%	5%	10%	15%	20%
Well-labelled data	90%	90%	90%	90%	90%
Partially labelled data	60%	60.60%	61.87%	63.57%	66.63%
Noisy data	60%	48.51%	43.20%	39.37%	33.48%

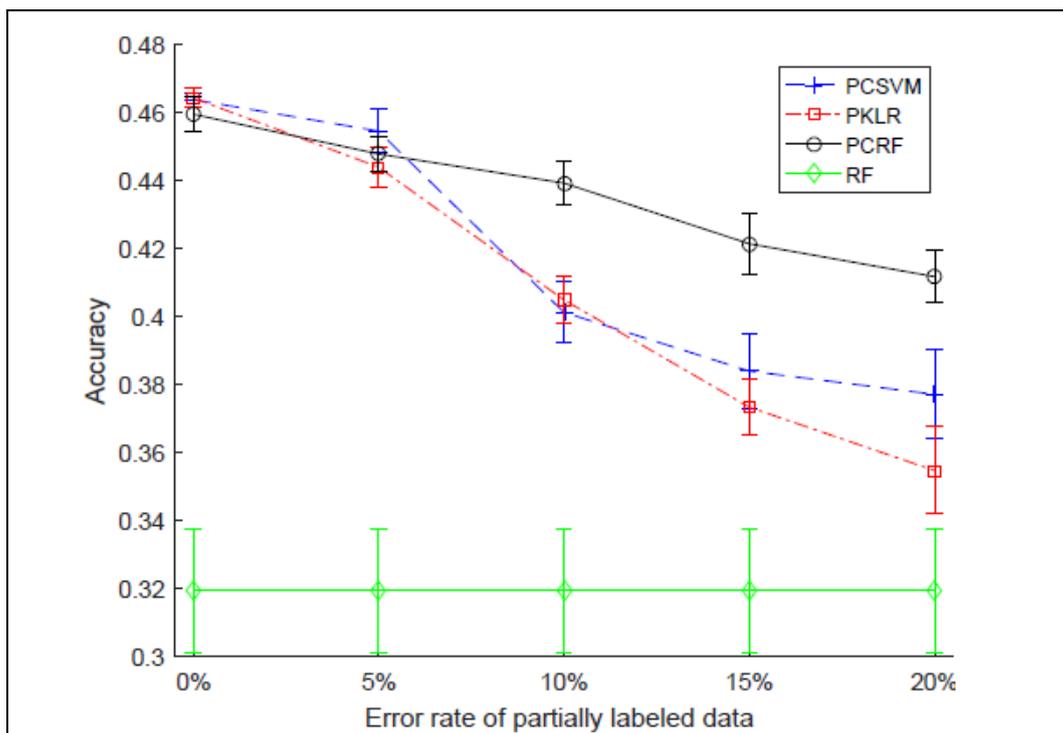
Compared With Other Algorithms

There are limited previous works on classification with a small well-labelled dataset and a large pairwise constraint dataset. As shown in Nguyen & Nam's research (2008), the PCSVM proposed by them reached the state-of-the-art performance and PKLR (Yan et al. 2006) works better when the data is limited. Therefore, we compare our pairwise constraint Random Forest with PCSVM and PKLR in the dataset proposed above. In addition, to illustrate the effect of partially labelled data, we also test a normal Random Forest training with only well labelled dataset.

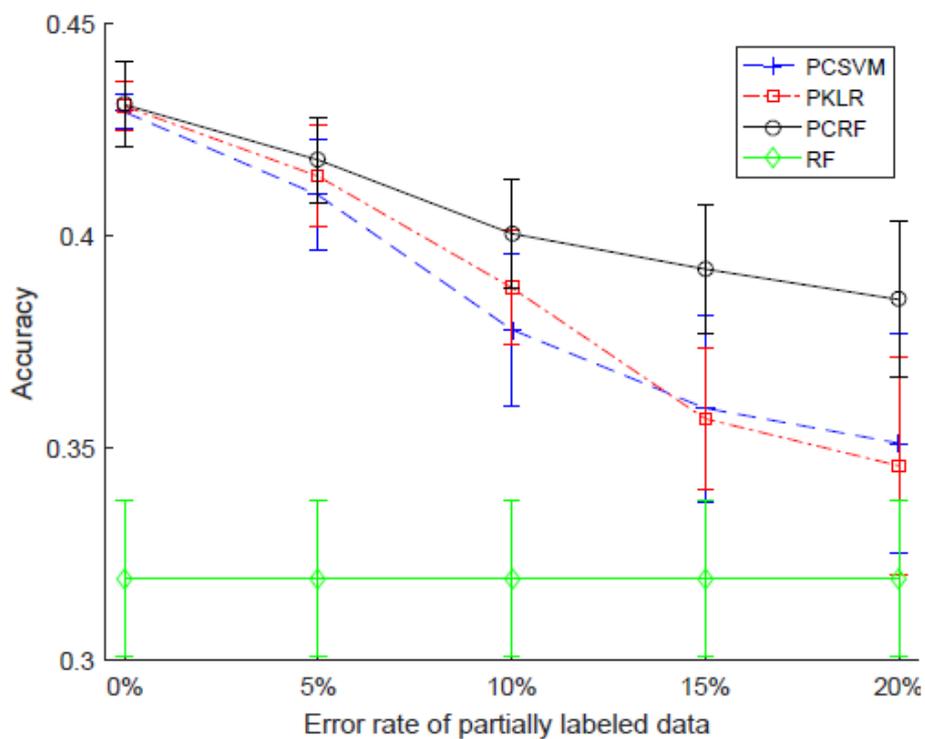
To get the best performance of each algorithm, we apply 5-fold cross validation to select best parameters. For the pairwise constraint Random Forest we set the number of trees to 150 and the learning rate for partially labelled data is set to 0.01. The dataset used in our experiments contains only limited well-labelled data and a lot of noisy information, so the stability of algorithm is important. To get the variance of different methods, we apply 5-fold validation on testing and choose the average accuracy along with variance as the results. Figure 1 and 2 shows the average performance of all attribute groups with Pairwise Constraint RF against PCSVM, PKLR and the normal Random Forest. When the noise rate is smaller, all algorithms get the similar accuracy, which means all algorithms work well with accurate pairwise constraint data. However, when the noise increases in the pairwise data, Pairwise Constraint Random Forest is more robust and performs better than PCSVM and PKLR.

Compared the results we get from small set and large set partially data in Figure 1 and 2, Pairwise Constraint Random Forest can handle both small and large set of partially data, and the variances of results on both datasets are smaller than others. But the increasing number of partially labelled training data usually result in a more robust module.





(a) Large set partially labelled training data



(b) Small set partially labelled training data

Figure 2. Results of Pairwise Constraint Random Forest on Animal with Attribute dataset

CONCLUSION

In this paper, we addressed the problem of the lack of well-labelled data for training attribute classifiers, grouped related attributes and proposed a Pairwise Constraint Random Forest which handles well labelled data and imperfect pairwise data at the same time. In the experiments, we extended two well-known attribute datasets with different noise rates and test the performance of Pairwise Constraint Random Forest on them. The results showed that the Pairwise Constraint Random Forest proposed in this paper works better than the previous methods on a large set of pairwise noisy data. In the future, we plan to use data collected from social media websites and extend this algorithm to work with different constraints.

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Investigating the Key Factor of Virtual Personal Brand in E-Commerce: A Case Study of “Myhomes”

(Full Paper)

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ABSTRACT

The new era of the Internet and e-commerce have introduced enormous amount of big data analysis and artificial intelligence to the world, and that bring better user experiences to consumers, and provide suppliers with a more systematic management. Since 2016, traditional e-commerce platforms encountered expansion bottlenecks, new sales approaches were launched, such as utilizing facebook fanpages for marketing and livestream to get more attentions. Companies and virtual personal brands also get exposures from social media Youtube, Instagram and etc., some individuals operate as self-media and called Youtubers, social influencer or key opinion leader economy. This self-media not only have changed how Internet marketing used to be, and subverted the ecology between Internet marketing and e-commerce. Therefore, this study aims to explore how virtual personal brand drives sales performance particularly in real estate agents by applying DeLone & McLean’s Information Systems Success Model to analysis success factors of Myhomes. The research reviews literature, interview platform users, and use study findings to evaluate how information system success model affect virtual personal brand positively, and why virtual personal brand is a significant ingredient for real estate agents to success.

Keywords: virtual personal brand, computer self-efficacy, information system success model, myhomes

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INTRODUCTION

The Internet usage rate in Taiwan is about 82%, and access from mobile devices reach 77% (TWNIC, 2018), which indicates the Internet is wildly used in Taiwan. Business opportunities from the Internet have sprouted especially to start-ups in innovative product and service investments. By introducing big data and artificial intelligence to e-commerce and Internet applications, platform system can develop optimal user experiences through data analysis, data exploration and data classification that allow consumers to use more intuitively, and platforms can obtain browsing paths while they are on the website (Mohd & Amit, 2018).

BACKGROUND

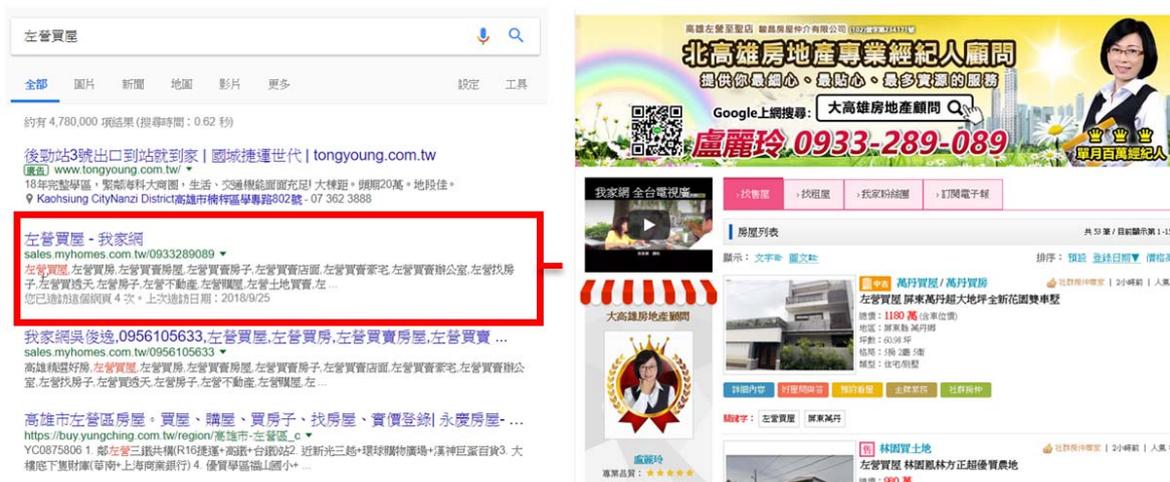
In 2016, the founder of Alibaba Group, Jack Ma, proposed that traditional e-commerce is dead, and a new retail era is coming (Perez, 2016). New retail is about associating e-commerce with retail stores, due to that consumers tended to be price oriented and lack of loyalty to a particular platform; new mobile technology and application development; challenges from retail stores of their evolving services. Retail market has new marketing approaches, such as through social media and livestream. Many of the Youtubers, social influencers and key opinion leaders have become self-media and its economy have influenced many young workers. A research from 1111 Job Bank in 2019 showed that 44.13% of the young workers wanted to become a Youtuber, among them, 31.65% would like to be a part-time Youtuber, 11.12% wanted to be a full-time Youtuber and 1.36% are already a Youtuber. Self-media not only changed how Internet marketing used to be, but subverted Internet media and e-commerce ecology (Schivinski & Dabrowski, 2014), that bring this study to discuss how virtual personal brand success under social media, by using Myhomes, a real estate platform as an example.

ABOUT MYHOMES

Myhomes is a real estate platform found in 2015, traditional platforms; for example, 591 Housing, Rakuya, House Fun and etc., have high reputation or flow, but the problem is that agents and properties have difficulties to be found among competitions. Myhomes acknowledged this issue, wanted to give a solution to this problem by building web-based virtual personal brand for the agents. Moreover, so they can be differentiated from competitors as well as becoming a community agent converged by contacts and network.

With continuous system optimization, Myhomes launched “community agent system 3.0” in December 2017, nearly 2, 700 agents and 74, 000 properties were listed in Myhomes, which indicated a strong result from the system. Furthermore, Myhomes introduced “community agent system 4.0” in 2018, which has six major features:

1. Google key word search optimization- agents can customize key words for specific properties or personal image, which means customers or potential buyers can easily link search results with preferred key words.



Source: This study
Figure 1: Google Key Word Search Optimization

2. Personal website- real estate agents can build his/her own personal website, on the top of the page is a personalized banner for added image to get buyers' attention. When a potential buyer was doing search within in a community agent's website, the result would only appear the particular agent's properties, and won't be tangled with other agents.



Source: This study
Figure 2: Personal Website

3. Exclusive image banner- it has clear contact information, his/her location or specialization, Google key words and QRcode for buyers to add the agent's communication application.



Source: This study
Figure 3: Exclusive Image Banner

4. Exclusive marketing integration with social media- by connecting communication application LINE and social media Facebook Messenger to a community agent’s website, buyers can text the agent without making a phone call, and the agent can respond to the inquiry instantly, both the agent and buyers can be benefited from this feature.



Instant Message Inquiry and Respond through Social Media

Source: This study

Figure 4: Exclusive Marketing Integration with Social Media

5. E-commerce education training course- since not all the agents are fully understand the meaning or how to build virtual person brand, Myhomes educates them how to incorporate reality with Internet marketing, as well as e-commerce skills, and to build virtual personal brand with Myhomes platform. Few of them could be computer illiterate, and there is also customer support to lead them step by step.



Source: This study

Figure 5: E-commerce Education Training Course

6. Web APP service- Taiwan has high mobile device usage rate, many e-commerce platform have developed application (APP) for easy access, Myhomes has mobile version webpage, and buyers can also install the web APP on their phones, they can browse a particular agent’s profile or properties directly by clicking an icon on the device.



Source: This study

Figure 6: Web APP Service

Those six features help real estate agents to increase sales, as November 2019, nearly 4, 800 agents and 124, 000 properties are listed in Myhomes, the growth almost quadrupled from 2015, which means agents are confident about the platform delivering the idea of building virtual personal brand.

RESEARCH PURPOSE

The study discusses how the real estate platform Myhomes indorses the concept of “brand for agent” or “virtual personal brand” in order to provide enhanced services, featuring: 1. Google key word search optimization; 2. Personal Website; 3. Exclusive image banner; 4. Exclusive marketing integration with social media; 5. E-commerce education training course; 6. Web APP service. The purposes of this research are: 1. Investigating how virtual personal brand can drive real estate agents to escalate sales. 2. Applying DeLone & McLean’s Information Systems Success Model to analysis success factors of Myhomes.

LITERATURE REVIEW

E-Commerce

The Internet is a revolutionary invention in human history, search engines in the begging e.g., Google and Yahoo could only find media content and news on the Internet. As blog era rinsed, search engine can excavate more information, and personal blog content has become prioritized then media or news. In the recent social media age, besides providing content or information, it is more about connecting life and friends in virtual society trough Facebook, Instagram and messaging APPs. Meanwhile, Amazon’s B2C e-commerce model, Ebay’s C2C model and Rakuten’s B2B2C model have reformed how shopping experience can be, and even advanced to international trade called cross-border e-commerce (Dai & Kaulffman, 2001; Yamamoto, Ishida & Ohta, 2004). Alibaba founder Ma advised that new retail model and big data analysis is the future, that are part of five topics to the new economy, including new retail, new manufacture, new technology, new finance and new energy source (ESC 2018). The essence of new retail relies on new data, algorithms and artificial intelligence technology. E-commerce is an exchange of product information on the Internet, it can lower costs for both companies and consumers, with immediate two-way communication. Zwass (1996) defined that e-commerce is based on the Internet allowing seller and buyer to communicate with each other, information infrastructure, information service and information product are major structures to form the services. Kalakota & Whinston (1997) added that e-commerce as a modern business practice is a transaction and automation application. Laudon & Traver (2002) considered that globalized e-commerce with variety of interactive information and personal data surly have altered how the world trade.

Customer Satisfaction

Customer satisfaction is how consumers feel about a product or service, in can be the cost, quality or what the customer received towards expectation. It is a result of before and post purchase, and customer compare the outcome of price versus performance (Churchill & Surprenant, 1982). Kotler et al. (2003) explained it as a feel of uplifting or disappointment, because satisfaction can be varied from the recognition of the quality of a product or service from user experience. Therefore, customer satisfaction is based on the experience, it reflects emotion state to expectation, and if the result was better than the expectation, customer satisfaction will be raised; on the contrast, if the outcome was negative or less than the expectation, there will be dissatisfaction. Since customers have diverse opinions and feelings, the measure of customer satisfaction needed to be done with a confident sample number. The degree of satisfaction can be much different than what was anticipated, because they have to engage with the product or service first, then the afterward experiences are for further examination (Yi & La, 2004).

Virtual Personal Brand

Brand used to be a method to be differentiated from competitors, now a days, it is adopted as a personal image appeal for consumers, and culture image for companies. Branding is a strategic implementation for corporations to generate maximum profits. A brand yields mixed inner feelings to consumers, building a virtual personal brand allows an individual to show his/her characters (Gelder, 2005). In addition, it is different from a product or a service, it an image in the mind, and a good brand can long-last in consumers' heart (Casaló, Flavián & Guinaliú, 2008). Peters (1997) mentioned in an article that everyone represents his/her own brand. McNally and Speak (2002) pointed out that each person has personalized brand, which can be utilized in products or services, further enlarged to groups, entertainment, sports and culture industries. Image after branding can have the public embrace the brand, and even be benefited from it (Keller, 2009). Moreover, variance of virtual personal brand offers stakeholders trust and approval that associate with positive image and recognition for personal competence. Personal brand can increase market share and mindshare as what a product can be, it can decrease the unfamiliarity of a product or a service, and bond the trusty image and commitment with consumer's emotion, which contributes to additional value. Personal brand is like a product, consumers can reflect feelings and have a chance to be linked with emotions (Arruda & Dixon, 2007). Lastly, personal brand in organizations or companies bring out the image towards co-worker, superior and customer.

Marketing Communication

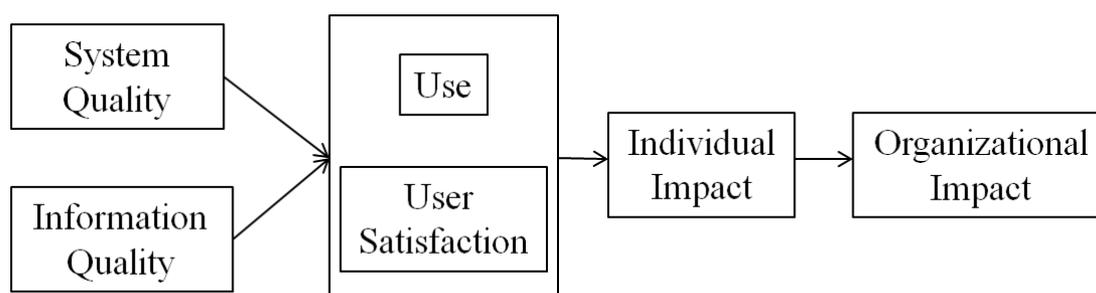
In order to compete and increase marketing share, positioning a product or service in a quality which consumers can trust is the advantage to segregate from competitions. Marketing to a particular group, based on its behavior and traits not only can grow recognition, but also to communicate with recipients closely, which is what a successful marketing is about (Madhavaram, Badrinarayanan & McDonald, 2013). Reece (2010) talked about the steps of a customer perceiving purchase cycle in new digital media: recognition, trial, purchase and referral. Social media is about a group of people with common interest and understanding, they communicate and share information through the Internet, with their joined interest, the added value from them can be used commercially (Fill, 2010).

Computer Self-Efficacy

Recent years, information management experts started to apply sociological theory in information technology researches, Compeau and Higgins (1995) expand the concept of self-efficacy and defined computer self-efficacy (CSE) as follow: CSE is not about what a person has done in the past, it can estimate and evaluate abilities for future references; furthermore, rather than functions like formation or calculation, it is about application analysis and assessment. Researches from Marakas et al. (1998) divided CSE into task-specific computer self-efficacy (SCSE) and general computer self-efficacy (GCSE). SCSE stands for task or skill oriented self-efficacy designated for a particular job, and it is not about computer capability. On the other hand, GCSE is general computer recognition across various fields. Self-efficacy is dynamic, it varies from research object's self-perception behavior. CSE brings positive effects to satisfaction, which is when a completion of a well-done job can convey to high performance appraisal and customer satisfaction (Bandura & Jurden, 1991). Compeau and Higgins emphasized Bandura (1986) CSE in four aspects: 1. Guided Mastery: it represents successful experiences within a person and computer, if the interaction is positive, it will have high CSE. The experience of operating a computer can alter CSE results, level of confidence, familiarity with computer and environment are some factors for determination. 2. Behavior Modeling: behavior and social value can be influenced by observing others, sometimes imitation occurs along the way. Compeau and Higgins found that behavior modeling can be related to computer training, and rise CSE and training simulation performances. 3. Social Persuasion: Compeau and Higgins believed that social persuasion affects CSE since user can be convinced to learn computer technology with great confident. 4. Physiological States: physical condition especially anxiety can decrease self-efficacy, Bandura explained it as the lack of computer ability can cause anxiety and tied to performances decline.

Information System Success Model

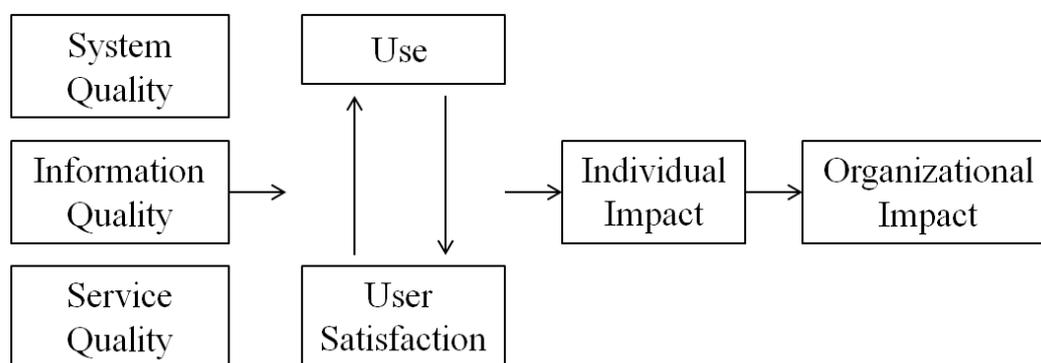
Information system construction started to become a social trend in 1990s, there have been many studies on its results; for instance, DeLone & McLean's (1992) information system model, Seddon's (1997) information system successful extension mode, Molla & Licker's (2001) e-commerce successful mode, and DeLone & McLean's updated model in 2003. Businesses started to utilize information system for enhanced technology and organization managerial advantages. Information system is an integration of man and machine, it includes hardware, software, application process, data base, communication, gather and transfer information to manage or operate routine and decisive activities. The six structures from DeLone & McLean (1992) include: system quality, information quality, use, user satisfaction, individual impact and organizational impact



Source: DeLone & McLean (1992)

Figure 7: Information System Success Model

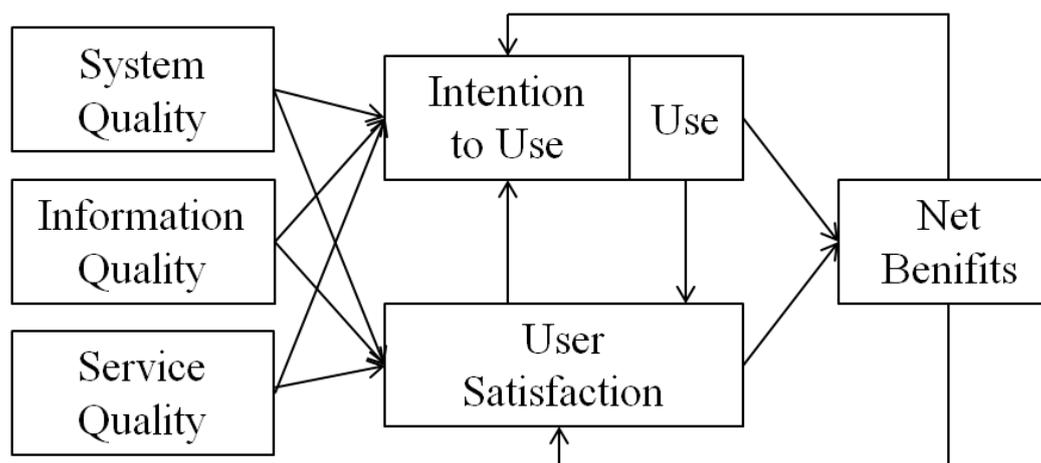
Pitt, Watson & Kavan (1995) discussed that information department is not only about product, but also software installation, tech support, education, Internet connection and other related services. Information quality evaluation contents information quality, system quality and service quality.



Source: Pitt, Watson & Kavan (1995)

Figure 8: Expansion of Information System Success Model

DeLone & McLean (2003) edited the information system success model and incorporate Pitt, Watson & Kavan's (1995) model to enhance service quality, including system quality, information quality, service quality, intention to use, user satisfaction and net benefits.



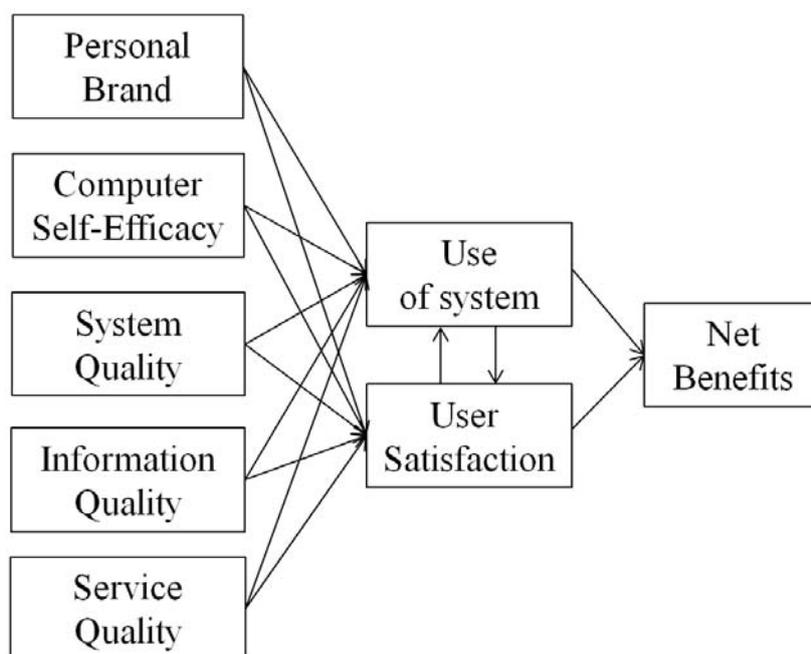
Source: DeLone & McLean (2003)

Figure 9: Updated Information Systems Success Model

RESULT

The study uses literature review, interview with agents, and use study findings to evaluate how information system success model affect virtual personal brand. The results are that virtual personal brand, computer self-efficacy, system quality, information quality and service quality will positively affect the use of Myhomes system; virtual personal brand, computer self-efficacy, system quality, information quality and service quality will positively affect Myhomes user satisfaction; use of system and user satisfaction are interrelated, and the result will positively affect Myhomes net benefits.

Myhomes provides real estate agents a platform to build virtual personal brand and to excel in computer self-efficacy; in addition, Myhomes offers substantial system quality, information quality and service quality for optimal platform experiences with positive results. With all those factors affecting the use of system and user satisfaction, Myhomes can have the outcome of significant net benefits.



Source: DeLone & McLean (2003), this study
Figure 10: Result Framework

CONCLUSION

In modern marketing and e-commerce, personal brand is an important factor to success, no matter what era it is, in order to surpass competitions, building a virtual personal brand can have positive image appeal and displaying commitment; he/she can have higher recognition for personal competence; a person can increase his/her market share and mindshare; virtual personal brand affects co-worker, superior and customer closely. In this age of social media, Youtuber or social influencer economy has competitions with individuals in an unprecedented state, building a personal image and establish a virtual brand is beneficial in this circumstance.

Virtual personal brand is a significant ingredient to new retail, e-commerce and to platforms, Myhomes benefits real estate agents by building virtual personal brand and increase CSE performances. Agents do receive more inquiries from potential buyers and lead to escalate sales and customer satisfaction. Factors from DeLone & McLean's Information Systems Success Model, virtual personal brand, computer self-efficacy, system quality, information quality and service quality positively affect Myhomes.

Further study could be done on business model for virtual personal brand in e-commerce with other factors. Beside real estate agents, research could be done on platform user experience from customers and potential buyers. E-commerce and self-media have different practices in different regions, since there are barriers in culture, technology and infrastructure, with the connection of the Internet, virtual personal brand can be seen and interacted around the global.

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Knowledge Seeking: The New Horizon on Knowledge Management

(Full Paper)

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ABSTRACT

This study reviews the definition and development of Knowledge Management (KM) and discusses the differences of knowledge sharing and knowledge seeking in KM. Knowledge sharing has long been regarded as the most important factor in Knowledge Management implementations. However, this research discussed the three barriers of existing knowledge sharing in KM. Based on this discussion, it is proposed by authors that it is the knowledge seeking rather than knowledge sharing that plays the crucial role in KM.

Key words: Knowledge Management; knowledge sharing; knowledge seeking.

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INTRODUCTION

According to Szulanski (2000, p10), "the mere possession of potentially valuable knowledge somewhere within an organization does not mean that other parts of the organization benefit from this knowledge". Based on this kind of assumption, many researchers or practitioners thus emphasise the importance of knowledge transfer within the organization or between organizations (such as Li-Hua, 2006). As a result, knowledge sharing, as the major method of knowledge transfer, becomes the starting point of knowledge management. It has become one of the main goals of KM initiatives to encourage and improve knowledge sharing within organizations. Many organizations have invested large amounts of time and money to develop knowledge management systems employing state-of-the-art technologies to facilitate important knowledge sharing activities. However, according to Babcock (2004), this investment results in huge financial losses among Fortune 500 companies due to the failure of sharing knowledge. It is thus reasonable to ask some fundamental questions around knowledge sharing: Is knowledge sharing the fundamental means of knowledge management? This led the authors to explore new approaches promoting knowledge management in organizations.

After the discussion of the knowledge sharing barriers based on the review of the KM definition and development, this research proposes that it is knowledge seeking rather than knowledge sharing, among others, that makes knowledge transfer or knowledge creation possible. This implies that it is not enough just to emphasize the knowledge sharing and stress on the knowledge sharer or pushing side. We should pay more attention to the opposite side of knowledge sharing, to those who actively seek solutions for the problems or challenges they meet at work, namely 'knowledge seeking'. Obviously, knowledge management could be remarkably improved if we are able to understand knowledge seeking process.

BACKGROUND OF THE KM DEVELOPMENT

The rapid development of KM is attributed to three key drivers, namely economic driver, social driver, and organizational driver.

The Economic Driver For KM

From an economist's perspective, there are many factors contributing to economic or productivity growth. Early economic growth models mainly focused on the capital factors, until Solow (1956) proposed his economic growth model: a neoclassical growth model. According to Solow (1956), the main inputs, including labour and capital, only have short run implications for economic growth. The long-run rate of growth will be exogenously determined by the rate of technology progress. Solow's model takes technological advancement into account and regards the level of technology as a parameter in it. Since then, knowledge and technological advancement have become more and more important in economists' theories.

After Solow (1956), many economists have expanded his model and developed many new models, which endogenize technology and knowledge factors, and thus are named as endogenous economic growth models (such as Romer, 1986; Grossman & Helpman, 1990). This evolution in the new economic growth models demands technological advancement. They regarded technological change or the introduction of new technology as the foundation of economic growth. Therefore, research and development (R&D), technological advancement, and innovation have become a main theme in economic growth and business, which becomes the economic driver for KM.

The Social Driver For KM

According to Hislop (2009), the theoretical foundations or key assumptions on which knowledge management literatures are typically based are the conceptions of the knowledge society (Drucker, 1966; 1969) or post-industrial society (Bell, 1974). The concept of the 'knowledge worker' introduced by Drucker (1966) distinguishes the 'knowledge worker' from the traditional 'manual worker'. Drucker (1969) also described a knowledge society, and employed the concept of 'discontinuity' to depict the major changes in the underlying social and cultural reality. These emergent changes or 'discontinuity' include the rapid emergence of new technologies, and the knowledge economy. It is proposed that management should respond to this transition to fit the characteristics of knowledge work. Namely, these social changes call for new approaches from managers and knowledge workers. The concept of the 'post-industrial society' introduced by Daniel Bell (1974) depicts the social change from the middle of the nineteenth century. According to Bell, an industrial society is mainly based on manufacturing and fabrication; while in a post-industrial society, the biggest source of employment is no longer the manufacturing sector, but the service sector, in which knowledge and information play a more important role. For Bell, the professional service work will become critical in a post-industrial society as it dramatically demands the application of knowledge.

All in all, the nature of work has changed and knowledge has become the key asset for contemporary business organizations. This largely demands the employment of knowledge workers and the effective management of the knowledge in organizations. It is such a revolutionary change in our society and it explains the growth of interest in knowledge management since the 1990s.

The Organizational Driver for KM

'Competitive Advantage' has long been discussed by researchers and managers alike. Porter (1985) defined competitive advantage as the ability to earn returns on investment consistently above the average for the industry. From the perspective of 'resource-based theory', organizational sustained superior performance lies in its inimitable resources. A firm's resources include not only physical, or tangible resources, but also intangible resources. According to Halawi et al. (2005), valuable, uncommon, and poorly imitable resources comprise a firm's unique competencies and therefore present a lasting competitive advantage. In addition, intangible resources are normally more likely to gain this advantage than tangible sources. It is reasonable to argue that distinct knowledge should give the firm a competitive advantage. As stated by McEvily and Chakravarthy (1997, p1), "knowledge is presented as a particularly important resource in this regard". It has been generally proposed that sustainable competitive advantage is no longer rooted in physical assets or financial capital, but intellectual capital or knowledge (Sveiby & Risling, 1986; Drucker, 1993; Roos, et al., 1997; Koenig, 2002). Thus, how to manage knowledge inside an organization to gain competitive advantages becomes very important, especially in today's fiercely competitive business environment. This has become an organizational driver for the development of knowledge management.

KNOWLEDGE MANAGEMENT DEVELOPMENT

Knowledge management practices have been around for a long time. Even in our ancient society, many KM techniques have been employed among teachers, writers, or librarians, such as some form of narrative repository, knowledge sharing by means of meetings, workshops, mentoring sessions, and so on. As stated by Dalkir (2005, p12), "the primary technology used to transfer knowledge consisted of the people themselves". Clearly, KM has been practiced implicitly as long as the human beings have thought seriously about their work.

However, the actual concept of KM has arrived relatively recently. It became popular only after the 1990s. Especially since 1998, KM practices and research have been booming rapidly (Grant and Grant, 2008). If we regard the notion of the 'knowledge worker' by Drucker (1966) as the beginning of knowledge management (KM), the introduction of the concept of 'management of knowledge' at a European management conference in 1986 (Wiig, 1997) could be seen as the start of KM research. From then on, KM practices and research became a central management topic throughout most of the world.

Actually, many disciplines have informed KM development. As it has developed so rapidly and even a little chaotically, it is not easy to see a linear development in this area. The research in 'Intellectual Capital' by Sveiby and Risling (1986) has been seen as the start or origin of the KM movement (Grant & Grant, 2008; Koenig, 2002; Wiig, 1997; Martensson, 2000). This perspective regards knowledge as a kind of resource that exists outside human and social systems, like land or oil. These resources include skills, information, copyright, R&D, and other intangible assets. Peters (1992) argues that KM concerns leveraging these intellectual capitals. This kind of viewpoint can be found in many other research, such as Brooking (1997), Roos, et al. (1997), and Edvinsson (1997).

Now that knowledge is strategically valuable for organizations, it is natural that advanced technologies can be employed to store and share it. The rapid development of information communication technology thus enabled good opportunities for knowledge management, especially since the 1990s when the personal computer and the internet were widespread. Based on the perspective of 'intellectual capital' and information management, knowledge management mainly refers to the employment of information and communication technology to facilitate the acquisition, storage, and sharing knowledge. Many types of software, such as Lotus Notes, and many so-called knowledge management systems have been developed since 1990s. This approach to KM has been called the 'IT-track' of knowledge management (Sveiby, 2001; Mason & Pauleen, 2003; Gao et al., 2008; Vorakulpipat & Rezgui, 2008; Grant & Grant, 2008).

Compared to the 'IT-track', another origin of knowledge management can be regarded as the 'Soft-track' of KM, which emphasises the social nature of knowledge, and mainly focuses on the management of people and social processes. There are three main influential works informing this 'soft' aspect of knowledge management: the 'learning organization' by Senge (1990), 'community of practice' by Lave and Wenger (1991), and the SECI model by Nonaka (1995).

The concept of the learning organization (LO) is usually connected to organizational learning (OL). There is also big confusion around these two concepts. Firestone & McElroy (2004) regard the LO as the 'normative aspect' of OL. Although the idea of organizational learning emerged earlier (such as Argyris & Schon, 1978), the major turning point was the work of Senge (1990), which is the most popular and foundational work in the area. The central themes of both OL and LO is whether learning can be managed and how. However, compared to the training and human resources literature, which mainly stress individual learning and staff development, OL and LO are concerned with collective learning. As Senge (1990) argues, the LO is where people are continually learning to see the whole together. Further discussion of organizational learning will be presented in Chapter Four.

Lave and Wenger (1991) introduced another concept, community of practice (CoP), into knowledge management. The CoP is defined as a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice. In such a community, members are informally bound by what they do together. The CoP fulfils lots of functions with respect to the creation, accumulation, and diffusion of knowledge in an organization. Compared to the database and other repository, knowledge is retained in a 'living' way by a CoP (Kakabadse, 2003).

Nonaka's work and his SECI model (1995) can be regarded as one of the origins of KM because of its significant and influential role in this area, which has been evidenced by the fact that their work has become the most referenced material in this field. Referring to Polanyi's (1966) distinction between tacit and explicit knowledge, Nonaka focused on how knowledge was converted among the two different types. According to Nonaka (1995), in a knowledge creating company, tacit knowledge and explicit knowledge can be transferred through a spiral model which includes four steps: socialization, externalization, internalization, and combination. Apparently, Nonaka realised the social architecture of knowledge, and suggested that an appropriate environment should be created in organizations to provide a platform to share and create knowledge. He named this platform as a 'Ba'.

KNOWLEDGE SHARING IN KM

Why Knowledge Sharing

As stated by Kakabadse et al. (2003), there are various disciplines that have influenced and informed the field of KM thinking and practices including: philosophy, cognitive science, social science, management science, artificial intelligence, and so on. Consequently, there are lots of definitions of knowledge management and different KM practices.

According to Sveiby (2001), there are two broad approaches (or two tracks of activities) to knowledge management among the extant literature. One is IT-Track KM. It is based on the so-called 'hard' aspect, which focuses on the deployment and use of information technology. While the other one is People-Track KM. It is based on the so-called 'soft' aspect, which focuses on the capture and sharing of knowledge from the knowledge person to knowledge seekers. The first categorization of KM focuses on the management of information, while the second one centres on the management of people (Sveiby, 2001). The second categorization of KM takes an epistemological view of knowledge and regards knowledge as a social process. This scientific and philosophical view of the nature of knowledge itself has been accepted by many KM gurus, such as Nonaka and Takeuchi (1995), Davenport and Prusak (1998), Lave and Wenger (1991), and so on.

Arguably, all knowledge is personal. How can we manage the knowledge effectively and leverage it for the benefit of the organization? What if the staff leave the organization, such as through retirement, redundancy, resignation? How can we extract knowledge from individuals? These types of question lead many KM researchers and practitioners to think of knowledge sharing in the first place, to encourage people who have knowledge of the work in the organization to share their knowledge with other members of the organization. According to Szulanski (2000, p10), "the mere possession of potentially valuable knowledge somewhere within an organization does not mean that other parts of the organization benefit from this knowledge". Based on this kind of assumption, many researchers or practitioners thus emphasise the importance of knowledge transfer within the organization or between organizations (such as Li-Hua, 2006).

As a result, knowledge sharing, as the major method of knowledge transfer, becomes the starting point of knowledge management. It has become one of the main goals of KM initiatives to encourage and improve knowledge sharing within organizations. As stated by Wang and Noe (2010, p115), "knowledge sharing is the fundamental means through which employees can contribute to knowledge application, innovation, and ultimately the competitive advantage of the organization". For the most part, they normally focus on identifying the factors influencing individuals share their knowledge with others. These factors are normally from two major areas: organizational contexts, and individual & interpersonal factors. Factors from the organizational context include organizational structure, hierarchies, formal processes, leadership, and cultures (Sondergaard et al. 2007; Al-Alawi et al., 2007; McDermott & O'Dell, 2001). Research addressing individual & interpersonal factors mainly focus on staff's attitudes, behaviours, or individual personalities and dispositions on knowledge sharing (such as Judge and Bono, 2001; Cabrera et al., 2006; Lin, 2007); or motivational factors (such as Wasko & Faraj, 2000; Hew & Hara,

2007); or interpersonal relationship and social networks (such as Robinson, 1996; Abrams et al., 2003; Regans & McEvily, 2003; Cross & Cummings, 2004).

Through knowledge sharing, it is argued that individual knowledge will be transferred among members of organizations and become organizational knowledge in the end. According to Yang & Wu (2008), if staff can share their individual knowledge, the organization and individuals can both develop. This is the basic argument in many KM perspectives, although different ways to share might be suggested (such as Nonaka's SECI model, Lave and Wenger's CoP, and so on). Much of the KM literature about knowledge sharing mainly addresses these factors impacting the knowledge sharing process, which derive from two major areas: the organizational context, and individual and interpersonal factors. Research addressing the latter mainly focus on staff's attitudes, behaviours, or individual personalities and dispositions on knowledge sharing (such as Judge and Bono, 2001; Cabrera et al. 2006; Lin, 2007); or motivational factors (such as Wasko & Faraj, 2000; Hew & Hara, 2007); or interpersonal relationships and social networks (such as Robinson, 1996; Abrams et al. 2003; Regans & McEvily, 2003; Cross & Cummings, 2004).

Knowledge sharing research addressing the organizational context mainly focus on management support (such as Cabrera et al., 2006; Lee et al., 2006; Kulkarni et al., 2006), rewards and incentives (such as Bock et al., 2005; Kankanhalli et al., 2005; Yao et al., 2007), organizational structure (such as Kubo et al., 2001; Jones, 2005; Kim & Lee, 2006), and organizational culture. There is general agreement that a supportive organizational culture should be created for knowledge sharing (Davenport & Prusak, 1998; Park et al., 2004). Many organizational cultural dimensions have been linked to successful knowledge sharing, among which trust has become the most popular one (Park et al., 2004; Kankanhalli, et al. 2005). There has also been some research into multinational cultural issues around knowledge sharing (such as Ford & Chan, 2003; Lai & Graham, 2009).

KNOWLEDGE SHARING DILEMMAS

Many organizations have invested huge time and money to develop knowledge management systems employing state-of-the-art technologies to facilitate the knowledge sharing activities. However, according to Babcock (2004), this investment has resulted in huge financial losses among Fortune 500 companies, at least \$31.5 billion per year, due to a failure to share knowledge. It is also widely accepted that there are many barriers and problems with knowledge sharing, in addition to the factors discussed in the previous section. Bearing this in mind, it is reasonable to ask some fundamental questions around knowledge sharing: why should the individual share their knowledge? Is knowledge sharing the fundamental means of knowledge management? The following section will critically explore these knowledge sharing dilemmas.

Why Should I Share? The Root Of The Barriers

Based on a resource-based perspective or knowledge-based perspective to organizations, knowledge is seen as an important strategic asset or resource in organizations. Where knowledge is viewed as a kind of resource for organizations, knowledge sharing has been frequently explained by economic theories. Since knowledge sharing takes place in organizations, and among people, it has also been explored via social or behavioural theories. Whatever perspectives or theories we follow, the barriers to knowledge sharing are fundamental and from the root. As argued by Pfeffer (1997), the most fundamental question in organizational studies is how we understand the causes of behaviour. So what could cause people to share their knowledge?

From an economic perspective, the primary motivation of behaviour is self-interest. Knowledge sharing is similar to other traditional economics of tangible resources, which can be explained by a cost-benefit analysis. Based on this perspective, the scarcity of knowledge decides its value. Those who own the scarce knowledge will have a great advantage within or among organizations. These people would seek great benefit from the receivers or the organizations since they might lose their advantage or their benefit might be damaged if they share their knowledge with others. Why should they share their scarce knowledge? Various exchange theories have been introduced to explain the knowledge sharing behaviours.

Christensen (2005) argues that knowledge sharing is an exchange process where the individuals offer something of value while receiving something of value. In other words, the motivation for sharing knowledge is actually with the expectation of receiving something in return, such as more knowledge, money, or gratitude. Different exchange models try to explain how and when the returns are made. Some assume that all economic exchanges like this rest on the schema of giving and returning the equivalence, for example, Fiske (1991), Ferrary (2003), Boer, Van Baalen, and Kumar (2004). Christensen (2005) proposes three kinds of exchanges in knowledge sharing, namely financial, organizational, and social exchange. In financial exchange, the knowledge sharer receives a return with monetary rewards. Organizational exchange refers to the return by promotions or other measures related to organizational identities. Social exchange is mainly based on informal exchange of personal commitment and relationships.

Similar to exchange theory, social dilemma theory has been introduced to explain the knowledge sharing dilemmas. Social dilemma theory argues the paradoxical situations between individuals and the public (Cabrera, 2002). In this perspective, the sharing of knowledge between individuals is seen as one of the processes underlying collective knowledge. This collective knowledge is seen as a kind of public good, or the commons. The collective knowledge, as a kind of shared property, is open to every individual. There is an apparent benefit in letting as many individuals as possible share with the collective knowledge. However, if every individual just took from the collective knowledge without contributing to it, the commons would be damaged until nobody was able to benefit from it. This is named the tragedy of the commons, as everybody tries to maximize

individual payoff (Cabrera, 2002). As a consequence, collective damage will result. In other words, this is the paradox: individual rationality leads to collective irrationality (Kollock, 1998).

Since there is no restriction on access to the commons, namely the collective knowledge, individuals tend to enjoy the commons without contributing to it or exchanging with it. If you take from the commons without contributing or exchanging, you are enjoying the goods for free. Who does not like free things? It is a rational thought. However, if everyone acts like this rationally, nobody would cooperate, and eventually everybody will suffer this 'tragedy of the commons'.

This takes us back to the starting point: how can we encourage or facilitate people to share their knowledge, as they cannot be forced to do so. The willingness of individuals becomes critical here. Another kind of perspective, focusing on the intentions of behaviour, has been introduced to analyse knowledge sharing: the theory of reasoned action (TRA). According to Fishbein and Ajzen (1975), an individual's behaviour is determined by their intention to action, whilst this intention is determined jointly by their attitudes towards, and the subjective norms regarding their behaviour. Based on this framework, Bock, Zmud, Kim, and Lee (2005) propose three motivational drivers influencing individual attitudes towards knowledge sharing, namely, (1) anticipated extrinsic rewards from an economic perspective, (2) anticipated reciprocal relationships and sense of self-worth from a social psychological perspective, and (3) fairness, innovativeness, and affiliation from a sociological perspective.

The above discussion has illustrated the fundamental barriers existing in knowledge sharing. However, most current research about knowledge sharing tends to regard it as a linear, one-way process, in which the knowledge flows from the sharer to the receiver. This SRMC model normally includes a sender, a receiver, the message, and the context. This kind of model is able to illustrate the flow of knowledge and that the knowledge has been transferred. It does not demonstrate the whole process of how knowledge is shared, since knowledge sharing is a kind of exchange. In other words, it is an interactive process. Both giving and receiving should take place in the knowledge sharing process. In actuality, it is difficult to request people to simply share their knowledge because we are asking people to do what they do not want to do. We can only to encourage, provide incentives, or facilitate the knowledge sharing behaviours or processes, since the barriers are fundamental.

Existing Knowledge Versus New Knowledge

According to the perspective of knowledge sharing, individuals have knowledge in mind, and this knowledge should be shared and transferred in organizations (Yang & Wu, 2008; Wang & Noe, 2010). If knowledge cannot be effectively shared, then it is likely to fade away. Where face-to-face communication is not possible, we can rely on some technologies to capture this knowledge first. Then, we can find and utilize the knowledge later when we need it. Arguably, the sharing of existing knowledge within organizations will help them to effectively utilise available resources. This implies that 'knowledge sharing' is dealing with the existing knowledge in organizations. However, is the existing knowledge up to date, or has it been validated in a changing environment? Can the existing knowledge be utilized with a 'one size fits all' mentality? Will the people who receive the existing knowledge learn or create new knowledge? Can knowledge sharing alone help organizations gain or maintain their competitive advantages?

Knowledge sharing implies the transferring of some knowledge from one person to another (Al-Hawamdeh, 2003). This process results in the copying of knowledge, not the creation of new knowledge. However, as pointed out by Coulson-Thomas (2004, p88), "copying and sharing commodity knowledge is not the route to market leadership". New knowledge is increasingly important for organizations, as it is the source of competitive advantage (Porter, 1985; Conner, 1991; Halawi et al. 2005). Knowledge management, as a new management concept, helps organizations to create and leverage new knowledge to gain or maintain competitive advantage (Sveiby, 1986; Drucker, 1993). According to Coulson-Thomas (2004), KM should be an end-to-end process, from identifying knowledge requirements, to knowledge creation, sharing, and application, to enable innovation and deliver additional income streams. Most KM initiatives focus exclusively on the knowledge sharing part of the process, while knowledge creation and exploitation tend to be missing.

Knowledge creation, as a concept, was mainly introduced by Nonaka (1995). According to Nonaka (1995), in a knowledge creating company, knowledge is created through the interaction and intersection between tacit and explicit knowledge. This is a cyclical process in the form of a spiral and includes four steps: socialization, externalisation, internalisation, and combination. Although knowledge sharing, as a term, is not used in Nonaka's model, knowledge sharing activities have been stressed. For example, the socialisation phase and combination phase in the model actually refer to the sharing of tacit knowledge and explicit knowledge among colleagues respectively. According to Nonaka, it is such sharing of knowledge that makes knowledge creation become possible in organizations. In other words, knowledge sharing is a prerequisite of knowledge creation in organizations, and they are positively related.

This perspective has been questioned recently by Tatiana Andreeva (2009). According to Andreeva (2009), knowledge creation is usually expected to bring new knowledge or innovation compared to knowledge sharing which refers to copying or replication. To explore the relationships between knowledge sharing and knowledge creation, Andreeva (2009) conducted research in some knowledge-intensive companies in Russia. She found that individuals have preferences towards either new knowledge creation or existing knowledge sharing. Furthermore, a person cannot be inclined to both processes at the same time. The findings imply some contradictions between the knowledge sharing and knowledge creation processes. Thus the two processes are not positively related, as Nonaka proposed.

The differences between knowledge sharing and knowledge creating illustrate the different emphases on existing knowledge or new knowledge to be found within organizations. Although there are different viewpoints about these two knowledge related processes (i.e. positively related or not), they can be regarded as two independent processes both of which should be taken into account. When we are faced with a changing environment and today's modern society, new knowledge is crucial for gaining and maintaining competitive advantages, whilst sharing existing knowledge alone is apparently not enough.

Knowledge: Pull Versus Push

The main aim of knowledge sharing is to encourage people to contribute their knowledge, to transfer knowledge from the sharer to the receiver, so that knowledge can be effectively utilized. The problem here is what makes this transfer process happen in the first place when knowledge is still in the knowledge sharer's mind. Is it the sharer who initiates the knowledge transfer process or the receiver? In other words, is it the sharer, who pushes the knowledge to the receiver, or a seeker, who pulls the knowledge to himself, triggering the knowledge transfer process? Actually, this question has led to two different approaches in knowledge management: knowledge push (or supply-driven) approaches and knowledge pull (or demand-driven) approaches (Scarborough et al., 1998).

According to Alavi and Leidner's (2001), knowledge push approaches aim to increase the knowledge flow in organizations by capturing, codifying, and transmitting knowledge. This is actually another form of knowledge sharing: The sharer's knowledge is captured and codified in some format and then is transferred to the seeker. In contrast, knowledge pull approaches are concerned with the problems of engaging employees in the process of searching for and applying knowledge. The knowledge sharing perspective or knowledge push approaches tend to dominate the KM literatures. Much of them give emphasis to the employment of information technology to enhance knowledge capture, knowledge codification, and knowledge storing, especially the creation of knowledge databases, such as expert systems, or knowledge repositories.

Although knowledge is really important for organizations and has been regarded as a kind of asset, it is not really an object or entity like other assets. It is necessary to understand how knowledge is created or gained by people. As discussed in Chapter Four, knowledge is special and personal. It is embodied and resides in the heads of those who developed or constructed it. Thus, within practice-based perspective there is no fully explicit knowledge. All knowledge or knowing is personal, and cannot be disembodied from people. Knowledge is only developed by people themselves when they carry out activities and gain experiences. Within this perspective, there is no knowledge transfer process but instead a knowledge construction process or learning process. Bearing in mind the discussion about data, information, and knowledge, what is transferred is not knowledge but some form of data or information, which will help other people to learn or to construct knowledge that in turn belongs to themselves.

For instance, somebody shares his knowledge with you by giving you his notebook about solving some problems. However, you will never get that 'knowledge' in the notebook if you are not interested in it, or do not read it and learn from it. As the knowledge has been reduced to data or information when it was expressed or recorded (e.g. in the notebook) by the 'sharer', it is thus the 'seeker' who will construct the knowledge with the help of the data or information from the sharer or, even more, from others. Knowledge will not be 'shared' if the 'seeker' cannot or does not construct the knowledge by themselves. A similar situation in a classroom could serve as another example. The students are taught by the same teacher in the same way at the same time. However, the results could be quite varied, as there will be students of different abilities. In other words, the teacher is sharing his knowledge with the students in the same way, but the results of the knowledge sharing process will be different as a result of the different knowledge seekers (among some other factors). Therefore, in the knowledge sharing or transfer process, the key aspect is not the 'sharer' but the 'seeker' side as the nature of knowledge. The next question concerns how the 'seeker' starts to learn. Or, in other words, what triggers us to learn? The answer could also help us to understand what initiate the knowledge sharing or transferring process.

According to Larson (1991), as a kind of informal and incidental learning, workplace learning occurs most often when the learner is faced with an event or situation that is recognised as disconcerting or non-routine. As argued by Cseh, Marsick and Watkins (1999), a new life experience tends to provide a challenge, a problem to be resolved, informal and incidental learning normally begins with such kind trigger. This is to say that in a workplace, learning is normally triggered by a challenge or problem to be resolved. Then we tend to learn to solve the problem or meet the challenge. This kind of perspective is also similar to action learning. According to Revans (1982), learning is initiated when people question their own direct experience. In Revans' (1982) learning equation, learning is programmed knowledge plus questioning insight, which implies that individuals in the workplace learn from experience through reflection and action, usually to solve problems they meet at work. In other words, learning occurs in the process of finding solutions to problems in the workplace.

Based on this, the problem we meet is actually the trigger of a learning process. The person who encounters a problem or a challenge will then become a seeker to actively learn, or 'pull' the knowledge (if we see knowledge as an object) to solve the problem. At this time, if anyone would like to share his knowledge with the seeker, then a so-called knowledge sharing or transferring process will be started. Apparently, it is not the knowledge sharer, but the opposite side, the knowledge seeker, who is trying to seek or pull knowledge to solve the problem. It is the pull not the push that makes learning or knowledge transferring take place. This implies that simply 'pushing' the 'knowledge' to others does not mean a knowledge transfer

process will happen. Knowledge sharing can only provide help to others who want to learn or actively seek. Only when we are actively 'pulling', namely learning, can the knowledge be shared with or transferred to us.

KNOWLEDGE SEEKING IN KM

The above discussion about the dilemmas of knowledge sharing has demonstrated three fundamental problems. The authors researcher firmly stand on this point that it is knowledge seeking rather than knowledge sharing that makes knowledge transfer or knowledge creation possible. This implies that it is not enough just to emphasize knowledge sharing and give emphasis to the knowledge sharer or push side. We should pay more attention to the opposite side of knowledge sharing, to those who actively seek solutions for the problems or challenges they meet at work, namely 'knowledge seeking'. Thus, there is an apparent need to explore how knowledge seeking will take place, and what factors might be involved in this process.

Firstly, what is knowledge seeking? Some researchers have studied in this area, but it seems that there are different understandings of knowledge seeking. Various notions have been employed, each with a different focus, referring to the knowledge seeking process, such as knowledge acquisition, knowledge sourcing, knowledge creation and, even, information seeking. In some literatures they are even used in an overlapping way. For example, in Motwani's (2006) study knowledge acquisition, information acquisition, information gathering, and knowledge creation are used alternately referring to the same thing. Before a definition is given to knowledge seeking in this research, the related literature will be briefly reviewed.

Existing Research Related To Knowledge Seeking

There is not much research using the notion of knowledge seeking. Knowledge seeking mainly refers to behaviours associated with seeking knowledge from Electronic Knowledge Repositories (EKR). Apparently, these studies regard knowledge as an object or entity, and individuals can find it out when they need it. Kankanhalli, Tan, and Wei (2001) found that people can use the EKR as both contributors and seekers of knowledge. Prior researches mainly focused on the contributors, exploring how people share their knowledge to the system. So they conducted their research to formulate and test a theoretical model explaining an individual's knowledge seeking behaviour with the EKR. Three major factors were considered in their study, namely technology related factors (such as the quality of output, the use of EKR system), organization related factors (such as policies and procedures in the organization, and the reward systems), and task factors (such as task interdependence, knowledge tacitness). After analysis of the data collected from more than 100 knowledge workers, they concluded that technology characteristics and organizational characteristics have direct impact on knowledge seeking behaviour, while task characteristics play a moderating role in the knowledge seeking process.

Kankanhalli and Tan et al (2005) repost on further research to test the model relating potential antecedents to EKR usage. Their study reveals that perceived output quality, resource availability, task tacitness and interdependence, and incentives affect EKR usage for knowledge seeking. Following Kankanhalli, Tan, and Wei's (2001) study, Sanjeev and Gee-Woo (2005) employed the Decomposed Theory of Planned Behaviour and Technology Acceptance Model to investigate the factors influencing an individual's knowledge seeking behaviour in EKR, providing an understanding of the underlying psychological processes in knowledge seeking. Many factors have been identified as influential in knowledge seeking behaviour in EKR: perceived usefulness, seeking effort, trust, and information asymmetry.

To encourage knowledge transfer in organizations, collaboration has been regarded as very important in knowledge management. Bock, Kankanhalli, and Sharma (2006) conducted research to explore how collaborative norms in an organization influence knowledge seeking with regard to the EKR. According to them, collaborative norms positively influence individuals' knowledge seeking from EKR.

There are some other notions used in KM literature similar to the meaning of knowledge seeking, for example, knowledge creation and knowledge sourcing. Nonaka and Takeuchi (1995) argue that knowledge will be created when tacit and explicit knowledge is interconverted in organizations. Gray and Meister (2004, 2005) use 'knowledge sourcing' to describe the activities in organizations in which individuals intentionally access each other's expertise, experience, insights, and opinions. According to them, knowledge sourcing methods refers to the specific mechanism by which an individual accesses another's knowledge, including those recently proposed in the KM literature (such as knowledge repositories) and well-established organizational practices (such as meetings). They classified three different types of knowledge sourcing, and argue that each method may support multiple forms of knowledge sourcing: dyadic knowledge sourcing, published knowledge sourcing, and group knowledge sourcing.

Gray and Meister (2004) propose a general model of knowledge sourcing, which includes contextual, dispositional antecedents, and learning outcomes. They attempted to identify knowledge sourcing effectiveness based on these three aspects. They concluded, from a survey, that knowledge sourcing explains a significant proportion of individuals' learning outcomes. In 2005, they made further efforts to explore whether different classes of knowledge sourcing methods produced different kinds of performance outcomes (Gray and Meister, 2005). This study revealed that different classes of methods were not as interchangeable as the KM literature might suggest. At the same time, they found that technology-based methods are not inherently superior or inferior to traditional methods.

Knowledge acquisition is another term related to knowledge seeking. Beveren (2002), for example, presented a model to describe the knowledge acquisition process. According to him, knowledge is different from information, and knowledge can only be created from the processing of information in our brain. Thus, the knowledge acquisition process is divided into two separate processes: outside and inside our brains. When we acquire knowledge, we acquire information through the sensors at the first stage. Then this information is processed in the brain by using prior knowledge, during which new knowledge may be acquired or created. Apparently, this perspective on knowledge acquisition is based on information processing learning theory, which regards information processing as a black box, a psychological process in the brain.

Zhou (2004) related tacit knowledge acquisition to the study of intelligence. He argues that practical intelligence concerns problem solving, problem finding and knowledge acquisition. Assimakopoulos and Yan (2006) explored how Chinese software engineers acquired codified and tacit knowledge in their daily work. They argue that knowledge acquisition refers to a series of activities, such as seeking advice, learning to solve technical problems and so on. Some sources of knowledge seeking have been identified in their study: for example, technical books and online searching, local community of practice, and personal networks.

Knowledge acquisition also appears in the computing science literatures in the field of knowledge-based systems or expert systems. Brewster, Ciravegna and Wilks (2001, p1) argue that, “for knowledge to be managed it must first of all be captured or acquired in some useful form, e.g. stored in an ontology”. According to Gebus and Leiviska (2007), knowledge acquisition implies how we extract knowledge from experts and represent it in a knowledge-based system, and this activity is normally carried out by a knowledge engineer. From a computing science perspective, the research in knowledge acquisition focuses on how to employ or develop new techniques to extract knowledge, how to define the ontology in the database, and how to automate the knowledge acquisition process to reduce time or cost, and so on.

Knowledge Seeking Is A Learning Process

To define knowledge seeking, the meaning of knowledge needs to be clarified. Many learning theories have been developed to explain how knowledge is created, from the behaviourist theories in the early stages, like Pavlov, which emphasizes the principle of ‘stimulus-response’, to the cognitive theories, like Bandura and Weiner, which focus on the internal processes of the mind and view the learner as an information processor. Developed from cognitive theory, the constructivist view of learning argues that individuals construct knowledge through an interpretative interaction with the social world they experience. Knowledge is actively received either through the senses or by way of communication (Von Glasersfeld, 1989). According to Vygotskian’s (1978) cognitive development perspective, the construction of knowledge is mediated by the socio-cultural context of its acquisition. Billett (1995, p21) argues that “appropriation involves an interpretative appraisal and construction of knowledge by individuals, rather than being a faithful representation of externally-derived stimuli”. Knowledge is a subjective concept and is always contextual. Jakubik (2007) argues that knowledge cannot exist in a vacuum and is not static, but is instead a dynamic concept created in social interactions. Therefore, the cognising subject actively constructs knowledge.

As a kind of adult learning, learning in the workplace is different from student learning. Conlon (2004) pointed out that much of what we learn in the workplace occurs during informal practice, namely, informal learning or incident learning. In Chapter Four, workplace-learning theories were reviewed, such as experiential learning, action learning, and situated learning. Apart from this, the most common way to describe knowledge is to distinguish it from data and information. Compared to information, knowledge is the product of the individual mind and it is subjective in the ontological sense (Searle 1996). As Stankosky (2006) argues, knowledge is ‘people based’ rather than ‘bits based’ and is about a ‘capacity to take action’. Knowledge is personal and is thought to be ‘internal in me’, while information is thought to be ‘external and outside me’ (Stankosky, 2006, p50).

If a person, with the help of information, is able to develop conceptual systems for the part of the environment acting as guidance, this person has developed knowledge (Johannessen et al, 2002). Maturana & Varela (1992) point out that all knowing depends on the structure of the knower and, without the existence of the knower, knowledge does not exist. “Knowledge is knowledge till it resides in the minds of people; once it is outside the human mind, it is information” (Al-Hawamdeh, 2003 in Singh 2007, p170). Only when information is actively processed in the mind of an individual through reflection, enlightenment, learning, or doing, can it be called knowledge. In other words, the known and knower are indivisible. This kind of perspective can also be found in many other literatures (Wilson, 2000; Jakubik, 2007; Hassell, 2007).

Most KM perspectives focus on the integration and coordination of the individual’s knowledge. They acknowledge the differences between information and knowledge and give emphasis to the social and cognitive attributes of knowledge. However, they view knowledge as a noun and try to capture and store it outside the human mind and share it in organizations. Given knowledge is a cognitive process in a human’s mind, how can it be codified, transferred and shared by technologies? The concepts of information and knowledge appear to be used in a confusing or overlapping manner in much of the research in the KM field. As stated by Wilson (2000, p50), “knowledge is knowable to the knower...it cannot be transmitted...only information about the knowledge can be recorded and accessed by another person”. Knowledge is different from information in that knowledge is always embodied and is always the experience of some individuals in a society (Hassell, 2007).

Even in Nonaka and Takeuchi’s SECI model, the application of the dualistic distinction of knowledge, tacit and explicit, is overly simplistic. As stated by Mooradian (2005), the tacit/explicit distinction of knowledge is ‘structural or relational’. They

cannot convert from one kind to another. Both kinds of knowledge actually support each other and ‘allow them to be acts of knowing’ (Mooradian, 2005). Given the definition of tacit knowledge, how can we externalise it easily? If it is created through doing, learning, and experience, how can tacit knowledge be ‘converted’ from another kind: explicit knowledge? Furthermore, knowledge is no longer real knowledge and is reduced to information for others, once it is divorced from one’s mind. Even so-called explicit knowledge needs a cognitive learning process to ‘convert’ from information into knowledge.

As Churchman (1971) argues, knowledge resides in the user and not in the collection of information. This implies that having more information does not necessarily lead to enhanced knowledge creation. Simply delivering or ‘pushing’ information to a user’s desktop may not be an effective approach to the management of knowledge, due to the lack of the user’s attention that is required for processing this information and constructing it into knowledge. Knowledge is created or constructed on the basis of ‘pull’ by individuals. This clearly tells us that KM is essentially a deeply social process, and that knowledge seeking (demand pull), compared to knowledge sharing (supply push), is the core and foundation of knowledge management. Without this vital link in the cycle of knowledge management, how can we put KM approaches into practice? Those traditional KM concepts that mainly emphasise information technologies and knowledge sharing are thus too neat and simple to survive in the workplace.

Defining Knowledge Seeking

Based on this new understanding of knowledge and learning theories discussed above, this researcher regards knowledge seeking within organizations as: A learning process, or a process of constructing knowledge, which results in the improvement of the seeker’s knowledge structure to solve problems or satisfy some goal.

This definition is placing emphasis on the cognitive process of knowledge construction within individuals, through information seeking, sense making, and learning by doing, by experiences, or by problem solving (see Figure 2). It is a learning process, which focuses on not only the meaning of the material (so-called data/information/knowledge) for the seekers in certain situational or organizational contexts, but also how they solve problems they meet, and what knowledge they gain or create eventually in their mind through this process. Without such a process, knowledge will not be constructed by individuals, and knowledge management will not demonstrate any difference to information management.

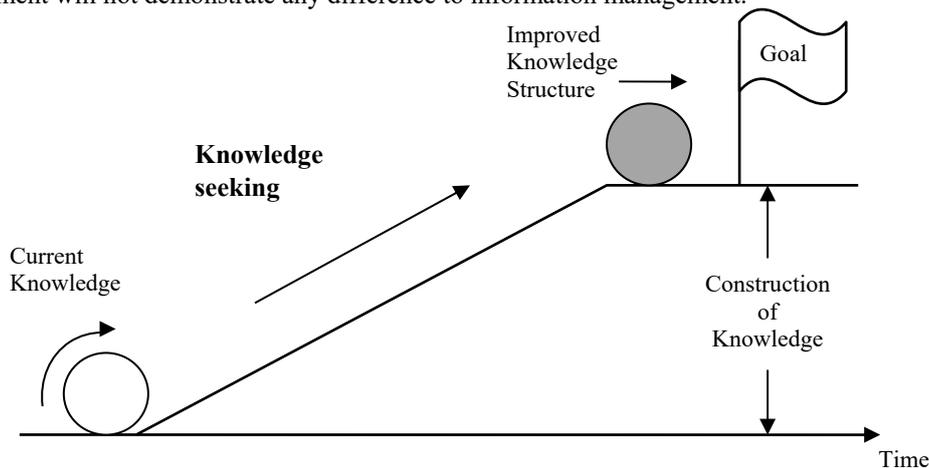


Figure 2: Knowledge construction in a workplace

Furthermore, the concept of ‘knowledge seeking’ here is different from knowledge sourcing, knowledge acquisition, information seeking, and knowledge seeking as found in literature. According to Wilson (2000), information seeking behaviour is the purposive seeking for information as a consequence of a need to satisfy some goal. This implies giving emphasis to what kind material or fodder the seekers are looking for in order to satisfy their goal. The concepts of knowledge sourcing, knowledge acquisition and knowledge seeking refer to finding out ‘knowledge’ from somewhere. As stated by King, Chung & Haney (2008), knowledge acquisition involves the search for, recognition of, and assimilation of potentially valuable knowledge, often from outside the organization. This viewpoint tends to regard knowledge as something existing somewhere and means to seek or find it out, which is no different to information seeking as described above.

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Modelling Management Consulting in India: Towards Management Consulting Theory

(Full Paper)

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ABSTRACT

This point-in-time, management consulting firm (MCF), empirical, global literature-supported quantitative study, engages a small but acceptable dataset. It builds a significant MCF-to-client-firm sustainable business positioning model to assist the client-firm (CF). The model's total effects highlight where MCF-to-CF improvements can likely produce greatest impact pathways onto CF outcomes. A new Management-Consulting-Theory is presented. Management Consulting Theory enlists current MCF competencies, and uses these to help create a collaborative suite of optimizable MCF-to-CF values and competitive intelligences capabilities. When suitably focused, this engaged system of MCF competencies, and its CF-absorbed MCF-to-CF capabilities enhancements, can jointly influence the enhancement of a CF sustainable business positioning - ideally one that remains adaptive, and also promotes an ongoing CF sustainable (competitive) business positioning.

Keywords: Management consulting theory, business competitiveness, knowledge management, structural path model, innovation and intelligence, digital transformation, sustainable business positioning.

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INTRODUCTION

Management Consulting Firms (MCFs)

MCFs engage management consultants (MCs) to strategically transfer their relevant 'MCF expert' advice through to the client firm (CF). MCFs and their MCs through co-created new CF values deliverance processes provide business outcomes solutions (Breidbach & Maglio, 2016). The MCF-to-CF transfer aims to create a new competitive business positioning (Whittington, 2006; Srinivasan, 2014; McMakin & Fletcher, 2018) that can then meet ongoing global challenges (Jensen et al., 2010; Srinivasan, 2014; Noe et al., 2017).

This active MCF-to-CF engagement boundary also varies according to a CF's deliverance expertise, its formal project responsibilities, and its personal reputation, along with the stage-reached within the specific MCF-to-CF consultancy (Sturdy & Wright, 2011). Thus, the role of MCFs and their MCs remains complex, engaging, theoretically-framed, and CF relationship intensive.

Research Agenda

MCFs and CFs continually migrate business models and the embedded applications towards consumer-demanding solutions (Clun, 2017). Hence, they pursue an enhanced sustainable competitive business positioning (Jednak & Kragulj, 2015; Stefanikova, et al., 2015; Dyllick & Muff, 2016; Cavaleri & Shabana, 2018). Hence, this study's research question asks:

'Can MCF-to-CF transference processes assist in delivering a sustainable (competitive) business positioning for the CF?'

MCF DELIVERANCE FRAMEWORK

MCF-To-CF Pathway

MCs aim to enable and/or to add competitive intelligences and values capabilities to the CF's current business operations and its net competitiveness CF (Payne & Calton, 2002). Here, they engage strategies (managerial/customization skills-sets, knowledge, innovation, intellectual capital) selected to enhance the CF's operational capabilities and its ongoing business position (Brandon-Jones et al., 2016). Luu et al., (2016) shows as values, and CF effectiveness improve so does consumer loyalty, and ongoing sustainable business outcomes (Sánchez & Mitchell, 2017). The CFs with incentive to learn from external sources (such as a MCF) also arises under specific competitive knowledge learning conditions (Gazzola et al., 2011), and this can further promote a sustainable (competitive) business positioning (Sánchez & Mitchell, 2017). Figure 1 shows the relational pathway from MCF competencies, to MCF-to-CF capabilities, through to CF sustainable (competitive) business positioning.

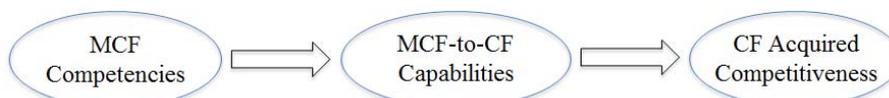


Figure 1. MCF-to-CF Business Positioning Pathway

Konlechner and Ambrosini (2019) consider 25 years of research, and suggest coherent management practices likely follow causal input-to-output pathways (firm competencies, into actions/results, and then into competitive outcomes) through to delivering ongoing (sustainable) advantage. Key research approaches include considering the firm’s (or CF’s) barriers to imitation, factor-mobility, and learning. Reed and DeFillippi (1991) suggest targeted firm investments across competencies (such as those developed by MCFs), likely generate multiple sources of advantage and uniqueness. Further, these developed MCF competencies can likely be enlisted when pursuing the competitive outcome positioning of engaged CFs. Hansen et al. (2013) adds these unique competencies offer potential pathways to competitive positioning, and particularly in highly competitive business environments. This is a scenario where the CF may choose to enlist the assistance of a MCF.

MCF-to-CF Framework

Within business management studies the competencies of a MCF as vehicles to creatively adjust its positioning is sometimes termed bricolage. The term has been applied by Visscher et al., (2018) to: (1) innovation (Garud & Karnøe, 2003; Halme, et al., 2012), (2) knowledge creation (Boxenbaum & Rouleau, 2011; Duymedjian & Ruling, 2010), (3) entrepreneurial intellectual capital (Baker et al., 2003; Fisher, 2012) and (4) group and understand the skills-set of a firm (Perkmann & Spicer, 2014; Weick, 1993). The term bricolage is also incorporated as a combinations problem solving tool (Senyard et al., 2014) that is then capable of solving uncertainty situations - such as those encountered in a MCF-to-CF transference process.

Konlechner and Ambrosini (2019) develop a framework incorporating causal competencies (resources, skills-sets, knowledge, and technologies) that then delivers both firm performance values and competitive firm learning. Thus, they help establish the literature support for the MCF-to-CF pathways from competencies to capabilities. MCFs share their researched skills-sets, innovation (radical, incremental or imitation), new knowledge and intellectual capital (or new information) with the CF (Christensen et al., (2013; Cavaleri and Shabana, 2018). These four MCF competencies of Figure 2 then support the repositioning of the CF’s existing utilitarian values (qualities, performance and economic worth) (Jones et al., 2006; Hamilton et al., 2014), along with the repositioning of the CF’s competitive intelligences (Werth et al., 2016a; 2016b). From these MCF-to-CF capabilities relationships, a level of CF recognition and trust may arise (Rangan & Dhanapal, 2016).

Petroni, (2000), and Teo and Choo (2001) show MCF competencies offer pathways towards price-competitive high quality products/services, and towards a positive return on investment, whilst Lee and Jung (2018) find competencies constructs do form pathways into quality capabilities (Figure 2). Rangan and Dhanapal (2016) suggest MCFs who consistently deliver credible, technically-competent CF capabilities solutions across their connectivities channels, then likely earn trust, and/or sustainability recognition. Dyllick and Muff (2016) add sustainable business positioning is delivered when internal business challenges are effectively and efficiently performance-capabilities solved.

The above discussion, and Figure 1’s MCF-to-CF Sustainable Business Positioning Pathway, suggests when consulting with a CF, the MCF’s engagement competencies and its deliverance capabilities (utilitarian values and competitive intelligences) interplay to deliver a sustainable (competitive) business positioning solution. This is presented visually as the MCF-to-CF Business Positioning Deliverance Framework (Figure 2).

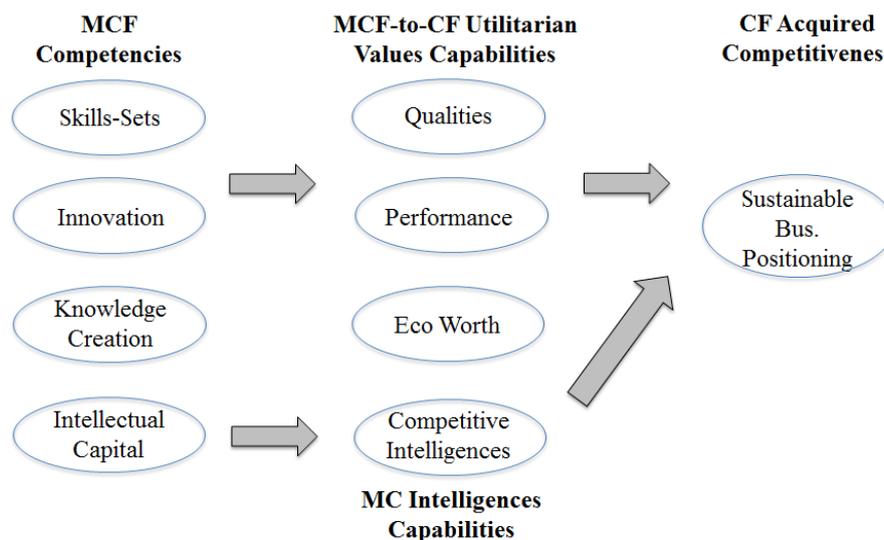


Figure 2: MCF-to-CF Business Positioning Framework

MCF Competencies

Kache and Seuring (2017) suggest existing CF business modelling likely lacks the flexibility to capture (and utilize) both real-time process and current external information. Hence, CFs engage MCFs to pursue such flexibility via a MCF-to-CF capabilities assimilation process and to target further CF management and financial goals (Liu et al., 2016).

The MCF's enabling competencies suite (skills, materials, expertise, functions, and prices) helps support the CF's planned capabilities (better performance, better planning, and new service successes) across its existing and/or new markets (Teo & Choo, 2001). Innovation brings new approaches, new technologies exploration, services innovation, visionary ideas, new ventures, and innovative attention/emphasis/measurement (Chen et al., 2009; Lubatkin et al., 2006). These coalesce as new ideas, creative thoughts, new imaginations, new applications or more effective services (Ettlie & Rosenthal, 2011; Hsieh et al., 2011).

Knowledge creation continuously combines, transfers, and conjointly analyses various knowledge formats. It is collaborative (Bronnemayer et al., 2016), a pioneering activity (Stoyanov et al., 2018) and both entrepreneurial, and performance-related (Li et al., 2009). Knowledge creation also houses strategic intelligence gathering, strategic analysis, interpretation, dissemination, and the development of futures scenarios (Trim & Lee, 2008). The competency 'intellectual capital' adds the MCF's research, infrastructure requirements, and big data information (Zhan et al., 2018) via knowledge acquisition practices, and/or via problem solving toolkits (Lee and Jung, 2018).

In Figure 2's MCF-to-CF capabilities context, the competencies-to-capabilities model pathways are supported by Liu et al., (2006) as sociotechnical competencies linkages of deep infrastructure knowledge absorbed into the collaborative practical CF capabilities of infrastructure competitive intelligences and CF state-of-the-art values capabilities practices (von Briel et al., 2019). Lee and Jung (2018) show the MCF competencies of knowledge creation, and intellectual capital provide pathways initiations through to the CF's quality capabilities. Bello et al., (2016) adds that such competencies covary. For example, the competencies knowledge creation, intellectual capital and workforce-skills each covary against changes in the MCF's innovation competencies, and so further the innovation construct. Thus all four competencies covary. The innovation competency also provides a direct pathway effect onto two of the MCF-to-CF capabilities (performance and economic worth).

MCF-To-CF Values Capabilities

Jones et al., (2006) links hedonic and utilitarian retail values as pathway initiators into loyalty and/or sustainability deliverance. Basole and Rouse (2008) use the input motives (or input competencies provided by the MCF) as links into a values domain network (performance, quality, economic and consumer servicing). These MCF-to-CF capabilities inclusions help to frame a positive business outcome. This business strategy approach to the utilitarian values then helps satisfy consumer needs, whilst focusing on economically-competitive sustainability (Kaltcheva et al., 2012).

The value domain of 'quality' is often gauged as 'service quality' (McLachlin, 2000). Zeithaml et al., (1990) offer five dimensions of service quality (reliability, responsiveness, assurance, empathy, tangibles). In MCF context the key CF service quality dimension is reliability – particularly in meeting agreed-upon goals (McLachlin, 2000). The MCF and the CF each pursue high levels of service quality capabilities throughout each of their consulting engagements.

The MCF offer CF improvements across the existing performance levels, capabilities, and workplace culture (McLachlin, 2000). Cannon et al., (2010) models the CF's performance capabilities against both its inputs and outcomes. Some quantify performance (cost, speed, dependability, quality and flexibility) against five lean business operational approaches (just-in-time, automation, kaizen, total productive maintenance, value stream mapping) (Belekoukias, 2014). However, the four most broadly used performance dimensions (efficiency, effectiveness, productivity, and flexibility) (Karwan & Markland, 2006; De Leeuw & Van den Berg, 2011) are engaged in this study as the MCF-to-CF items most directed towards achieving CF strategic objectives.

In the MCF context, economic worth capabilities follow Spanos and Lioukas's (2001) approach as external firm budgeting accomplishments (sales volume, growth-in-sales, market share, growth) (Bronnemayer et al., 2016), and as internal firm economic rents derived from strategic profitability activities (ROA, profit, ROI, ROE, net profit) (Sobol & Klein, 2009; Geletkanycz & Boyd, 2011; Bronnemayer et al., 2016). Further both MCF-to-CF economic worth dimensions are pathway initiators into CF sustainability.

MCF-To-CF Competitive Intelligence Capabilities

Competitive intelligences are akin to an intelligent network of collected human capital interconnected through knowledge creation and intellectual capital communication links (Heylighen, 2005; Ramanujam, 2012). Competitive intelligences offer high quality market information (Reinmoeller & Ansari, 2016), and offer the CF a pathway change that promotes its coherence in an ongoing but permanent (sustainable) way. This suggests as a CF knowledge evolution is ensuing, so are its linked, enhancing, learning, intelligences capabilities (Garrido, 2009).

Competitive intelligences embrace both business knowledge intelligences (which analyse business systems) (Brooks, et al, 2015; Larson & Chang, 2016), and collective intelligences (which gather and collate relevant external data into useful formats) (Chen et al 2014; Gruber 2008). Competitive intelligences contribute towards business strategic planning, competitor evaluation, and risk analysis (Stefanikova et al., 2015; Lopes-Robles et al, 2019).

Competitive intelligences can arise when firms gather multi-sourced (but partial) knowledge about their global markets and their competition (Fleisher, 2003; Tomek & Vavrova, 2011). Such firms may then strategically apply their competitive

intelligences as actionable-information aimed at advancing their performance, and towards producing a sustainable competitive advantage. (Stefanikova & Masarova, 2014). Thus an intermediate relational pathway between competitive intelligences and performance may also exist.

Bronnemayer et al., (2016) add competitive intelligences require the resourcing and competitive support of the top management (including the CEO). Competitive intelligences can also capture additional reflexive, anticipatory, cognitive competencies (like knowledge creation and intellectual capital) that target the molding the CF's individual reasoned-processes (Duarte Alonso et al., 2018). Laursen & Andersen (2016) and Umasuthan et al., (2017) suggest competitive intelligences can encompass a perceived mental state where the CF, through its top management, is in general alignment with MCF motives.

Yan et al., (2016) suggest meta-cognitive competitive intelligences approaches offer further learning via consumptive performance recognitions. Tan & Agnew (2016) see competitive intelligences through Interdependence Theory and the build of pathways through to sustainable business positioning relationships, whilst Alexandra (2018) engage Contact Theory and Meta-Cognitive Behaviour across culturally divergent environments. Thus, literature suggests recognition, collection, and rendering of competitive intelligences into the CF likely also encompasses behavioural cognitive and meta-cognitive dimensions.

The above Figure 2 MCF-to-CF values and competitive intelligences capabilities constructs capture the CF's practical/operational skills deliverance - where MCF-to-CF business-specific operational knowledge, and intelligent capabilities skills-sets are coalescing in the pursuit of producing an ongoing CF sustainable (competitive) business outcome.

CF Sustainable Business Positioning

Firms are 'sustainability entities' and by definition, they exist in-perpetuity. They acquire competitiveness by deploying their economic, social, corporate and environmental perspectives within their ever-changing business and global environments. Dyllick and Muff (2016) conclude today's truly sustainable firms seek competitive business solutions that ease financial conflicts, ease societal needs, innovate processes, and increase their sustainability positioning. They suggest collaborative partnerships can also increase the impact of the firm's sustainability approach strategies.

Hence, both MCFs and CFs each pursue, and seek to retain, their respective ongoing, individual, competitive business presence. Such approaches require a capacity to positively-engage across their resources (including: workforce, financials processes, systems, technologies, innovations, connectivities), and both likely each seek ongoing, externally-competitive (and beneficial) firm pathways designed to deliver their current and aspiration needs (Wikipedia, 2019). This is likely a trusting MCF-to-CF relationship where shared strategic exchanges bring manageable transactional costs, and develop inter-firm connectivities that then contribute towards enhancing competitive advantage (Hill et al., 2009; Zhang et al., 2011; Srinivasan, 2014). Thus, a CF's sustainable positioning outcome likely involves a system of ongoing, directed, and monitored MCF-to-CF deliverance systems.

Arjaliès and Mundy (2013) show in France's largest listed companies deliverance systems can contribute to sustainability through processes enabling: innovation, communication, reporting, plus assessing threats and opportunities. Gond et al., (2012) suggest seven competitive and values deliverance systems link into the production of a sustainable positioning within the firm's operationalized strategy. They also note these deliverance systems interactively (and diagnostically) applied across several prior business cases. Bruining, (2004), Widener, (2007), and Mundy, (2010) note that deliverance systems collectively contribute towards successful strategic sustainable business positioning pursuits.

Across MCF-to-CF consulting processes the CF deliverance systems behave similarly. Hence, this study follows the Gond et al., (2012) and Arjaliès and Mundy (2013) relationship view that a MCF-to-CF deployed, integrated-suite of deliverance capabilities systems can enable a CF sustainable business positioning - provided the approach is collectively-integrated, and not engaged as isolated autonomous strategic tools (Burgelman, 1991; Simons, 1995).

Cavaleri and Shabana (2018) conceptually-frame the operational initiatives driving a competitive and values enhancing business solution as a deliverance system that then supports a sustainable business positioning. Their input competencies model initiatives including competitive cost leadership, competitive differentiation, levels of innovation, and levels of imitation/innovation. These concepts are similar to, but less specific than, this empirical study's Figure 2 MCF input engagers. Cavaleri and Shabana (2018) suggest intermediary constructs capture deriving benefits or values, along with a competitive business and relational repositioning. This conceptual approach is aligned towards, but less specific than, this study's joint MCF-to-CF values and competitive intelligences deliverance approach. They also suggest a sustainable, competitive, financially-rewarding business advantage should be generated. The above studies suggest this study should include the CF sustainable business positioning as a model outcomes driver. Bronnemayer et al., (2016) measure the MCF's success in delivering an enhanced CF sustainable business positioning outcome as: a budget/scheduling deliverance, targets achieved, profitability, expansion-to-existing, and as extension-to-existing.

The above studies recognize a CF sustainable (competitive) business position remains a desirable and measurable relationship outcome. Hence, we model the MCF-CF relationship as one that delivers a sustainable (competitive) business positioning - where the MCF adds/delivers: all their CF-contracted services, highest value-for-money CF solutions, improved CF

qualities/performances, and promotes competitive/accelerated CF business growth. Thus, the nine constructs of Figure 2 can be defined by the measurement items shown in Table 1, and for consistency of analysis, these can be modelled using a country-specific approach. For this study, India is selected as a suitable, and substantive MCF and CF business environment.

MCF DELIVERANCE MODEL

India Perspective

MCFs in India often reside around major cities. MCFs are often geared towards developing 'business technologies incubators' and business entrepreneurship (Tang et al., 2013). India's top business school reports 31% of its 2018 class are now employed by top MCFs including: BCG, Deloitte, AT Kearney, Accenture Strategy, Bain, and McKinsey. Such top graduates are employed by MCFs to deliver further technical prowess, innovative initiatives, new knowledge management, and added intellectual capital to the CF, and within increasingly complex, and uncertain, competitive environments (Baud et al., 2014).

Across 2017-2018 and in India, McKinsey achieved double-digit growth. During this time Bain and Co has continued expanding its India operational sites at an annual rate of two new MC workplaces per year. Today, BCG (with 20% of its workforce in India) is the fastest growing MCF in India. Through to 2022, the MCF industry is projected to continually grow at around 6.8% annually, and by 2022 the India MCF industry should generate around \$2.5B in revenue.

Survey

This April 2017 online survey, offered through the Institute of Management Consultants of India, and available to the MC profession in India, adopted a Likert scale (1= strongly disagree to 5 = strongly agree) quantitative survey format. Initial responses from 182 management consultants delivered a final, usable, no-missing-values, complete data set of 112 cases - after the elimination of two outliers.

This 112 case study engages the Figure 2 nine near-normal distributed constructs. It meets the AMOS25.0 minimal sample size requirements for both confirmatory factor reduction to final construct development, and subsequent structural path modelling. Some past studies successfully model even with around 50 cases but with very simple structural models (Hoyle, 1995; Marsh et al., 2004). Kline (2005) suggests acceptable structural models can work from 100 plus cases per study. Chou and Bentler (1990) add that normally distributed data models can be generated with a minimum of five cases per construct. For this study this indicates normal item modelling can be derived from as low as 45 cases. Nunnally's (1967) 'rule-of-thumb' suggests 10 cases per construct as a minima for structural equation and/or path modelling.

Tinsley and Tinsley, (1987), Anderson and Gerbing, (1988), Ding, Velicer, and Harlow, (1995), and Tabachnick and Fidell, (2001) suggest a structural model minima of 100-150 cases/observations. The Muthén and Muthén (2002) rigorous simulation studies using near-normal constructs and no missing data suggest 150 confirmatory factor analysis cases are adequate. Thus, on balance, against past literature reported studies, this study's final sample size of 112 cases, and near-normality constructs/items, plus no missing values is of sufficient size for structural equation and/or path modelling.

The survey's demographic data shows 75% of MCF respondents are male. MCF respondent average age lies across the 31-45 years range, and 70% of MCF respondents hold either a Masters' Degree or a Ph.D. (7%). Respondents (68%) typically are in MCFs sized under 20,000 personnel. All respondents have past consulting experience, and 32% have participated in over 15 consulting projects. Most respondents consult on strategy (22%) or IT (32%). Thus, these MCF survey respondents likely match the profile of the industry and likely do understand their industry, its CF deliverables, and its CF targeted outcomes.

Data Collation And Preparation

This empirical study first engaged principal components, and Varimax factor analysis to further consolidate the compatibility of final factor items possible for each construct. This eliminated 20 poor load, cross-load, or non-factor items. Then remaining items were checked against the projected nine constructs. Next, these remaining items designated to a construct underwent factor (ML/Oblim) reduction - delivering nine final constructs (with all of remaining items showing residuals below 0.05).

Table 1 captures the above literature that delivered the nine constructs and their thirty-seven final quantitative survey response items. Table 1 shows each construct is gauged by its suitability measures. For example the MCF construct 'skillses' is captured from two literature studies and defined by five items - value for money, product focusing, high-quality products, excellent transactional value strategies and authentic and enduring organizational leadership approaches, these five items all load onto the construct at above 0.71 and deliver an average variance explained (AVE) of 0.63. This indicates a strong construct is delivered. The mean of 3.63 and standard deviation (SD) of 0.94 both indicate construct suitability. The Cronbach alpha of 0.89 indicates the construct has strong but not unidimensional internal consistency across its measurement items.

Across Table 1 each construct item loads - all but two (0.66, 0.69) item loads, exceeded 0.70. In one economic worth construct item an excessively high load of 0.97 was encountered. This item was necessarily retained to deliver the three item construct. All Cronbach alpha measures exceeded 0.70, and all construct AVE's exceeded 0.50 (Hair et al., 2014). The mean of each final construct lay between 3.5 and 3.9 (each with an acceptable SD). Thus, this study's constructs and their respective items are considered very likely to deliver an acceptable structural path model.

To further support structural equation and/or path modelling validity Table 2 shows as required, all constructs do significantly but only moderately correlate (Cunningham, 2008; Hair et al., 2014). Further, all eight constructs correlate with the CF outcomes construct sustainable business positioning. Thus, each factor reduction construct holds a discriminant validity suitable for AMOS25.0 structural equation and/or path analysis.

Data Analysis

This study adopts a structural path analysis approach as it seeks to understand the model and its staged progression, and because the authors would like a larger data set of 20 items per construct for definitive structural equation modeling (Hair et al., 2014). Constructs with their retained final items, are presented in Table 1. Again, all constructs correlate adequately (Table 2).

Table 1: MCF-to-CF Sustainable Business Positioning Measurement Data

LITERATURE ENGAGED	SURVEY RESPONSE ITEMS (N = 112)	LOAD	ALPHA	AVE MEAN	SD	
	MCF SKILLS-SETS		0.89	0.63	3.69	0.94
Weick, 1993; Petroni, 2000; Teo & Choo, 2001; Baker et al., 2003; Fisher, 2012;	offers CF value for money	0.84				
Perkmann & Spicer, 2014; Visscher et al., (2018)	offers CF product focusing	0.77				
	offers high quality CF products	0.86				
	delivers excellent transactional value strategies	0.78				
	delivers authentic and enduring CF organizational leadership approaches	0.71				
	MCF INNOVATION ADDITIONS		0.84	0.67	3.49	1.05
Vogus & Welbourne, 2003; Lubatkin et al., 2006; Chen et al., 2009; Halme, et al., 2012; Eisingerich, et al. 2009; Etlie & Rosenthal, 2011; Hsieh et al., 2011; Bello Trim & Lee, 2008; Li et al., 2009;	encourages us to innovate while solving CF problems	0.91				
	provides solutions to tomorrow's unknown problems	0.71				
	uses innovation to solve CF requests	0.82				
	MCF KNOWLEDGE CREATION		0.87	0.59	3.72	0.88
Duymedjian & R`uling, 2010; Khanna et al., 2011; Boxenbaum & Rouleau, 2011; Mohammed, 2011; Bronnemayer et al., 2016; Goedhart et al., 2017; Stoyanov et al., 2018; Visscher et al., 2018	looks for new CF opportunities and new markets	0.69				
	delivers knowledge-based CF infrastructure practices	0.81				
	adds our experienced-based knowledge to CF infrastructure practices	0.86				
	adds our expert-based knowledge to CF infrastructure practices	0.82				
	targets adding IoT capabilities to CF infrastructure practices	0.64				
	MCF INTELLECTUAL CAPITAL		0.90	0.63	3.66	0.9
Baker et al., 2003; Fisher, 2012; Liu et al., 2016; Kache & Seuring, 2017; Lee and Jung, 2018; Visscher et al., 2018; Zhan et al., 2018	shows-up in effective fieldwork procedure deliverables to CF	0.72				
	provides the social capital teamwork to make CF consulting world-class	0.83				
	uses personal intellectual capital to make CF consulting world-class	0.87				
	uses teams to make CF consulting world-class	0.78				
	makes each MCF quickly source, learn, transmit new knowledge to CF	0.76				
	ensures each MCF always quick to contemplate a CF assignment	0.72				
	MCF-to-CF COMPETITIVE INTELLIGENCES		0.82	0.61	3.71	0.9
Garrido, 2009; Tomek & Vavrova, 2011; Chen et al 2014; Brooks, et al, 2015; Stefanikova et al., 2015; Larson & Chang, 2016; Lopes-Robles et al, 2019	recognizes competitive intelligences as a necessity for CF's business success	0.79				
	collects CF information from many sources	0.78				
	communicates collected intelligences to the CF	0.78				
	MCF-to-CF QUALITIES		0.89	0.63	3.89	0.83
Zeithaml et al., 1990; Sheth et al., 1991; McLachlin, 2000; Roig et al., 2006; Basole & Rouse, 2008; Kaltcheva et al., 2012; Hamilton et al., 2014	sees MCs consistently delivering quality results to a request	0.76				
	sees MCs consistently respectful in assisting CFs	0.79				
	sees MCs consistently bringing new skilling into the CF's workforce	0.84				
	sees MCs changes as improving qualities of CF's business opportunities	0.91				
	sees MCs changes highlighting where CF's can reliably excel against competitors	0.66				
	MCF-to-CF PERFORMANCE		0.90	0.70	3.77	0.96
Karwan & Markland, 2006; Cannon et al., 2010; Kaltcheva et al., 2012; Belekoukias, 2014; De Leeuw & Van den Berg, 2011	sees high levels of optimized business outcomes	0.75				
	sees high performing MCF-CF shared relationships	1.00				
	sees secure, comforting, MCF-CF-workforce environments	0.74				
	MCF-to-CF ECONOMIC WORTH		0.86	0.75	3.56	1.07
Spanos & Lioukas, 2001; Sobol & Klein, 2009; Geletkanycz & Boyd, 2011;	sees outcomes are worthwhile for monies being invested	0.78				
Kaltcheva et al., 2012; Bronnemayer et al., 2016	sees profitable consumer items from the monies invested	0.85				
	sees financially rewarding consumer services from the monies invested	0.97				
	CF SUSTAINABLE BUSINESS POSITIONING		0.87	0.65	3.68	0.99
Bruining, 2004, Widener, 2007, Mundy, 2010; Hill et al., 2009; Zhang et al., 2011;	sees all the contracted services delivered	0.80				
Gond et al., 2012; Kaltcheva et al., 2012;	sees highest value for money delivered	0.75				
Srinivasan, 2014; Dyllick & Muff, 2016;	sees all CF firm qualities/performances responsibly delivered	0.94				
Cavaleri & Shabana, 2018	sees accelerated competitive CF firm business growth delivered	0.72				

Table 2: MCF-to-CF Sustainable Business Positioning Model Implied Correlations

CORRELATIONS	Intellectual Capital	Skills-Sets	Knowledge Creation	Innovation Additions	Qualities	Performance	Eco Worth	Competitive Intelligences
Intellectual Capital	1							
Skills-Sets	0.75	1.00						
Knowledge Creation	0.67	0.67	1.00					
Innovation Additions	0.70	0.70	0.62	1.00				
Qualities	0.70	0.71	0.66	0.58	1.00			
Performance	0.61	0.62	0.57	0.58	0.80	1.00		
Eco Worth	0.64	0.58	0.62	0.55	0.65	0.69	1.00	
Competitive Intelligences	0.67	0.57	0.66	0.53	0.54	0.47	0.50	1.00
Sustainable Bus. Positioning	0.63	0.59	0.61	0.52	0.71	0.63	0.66	0.62

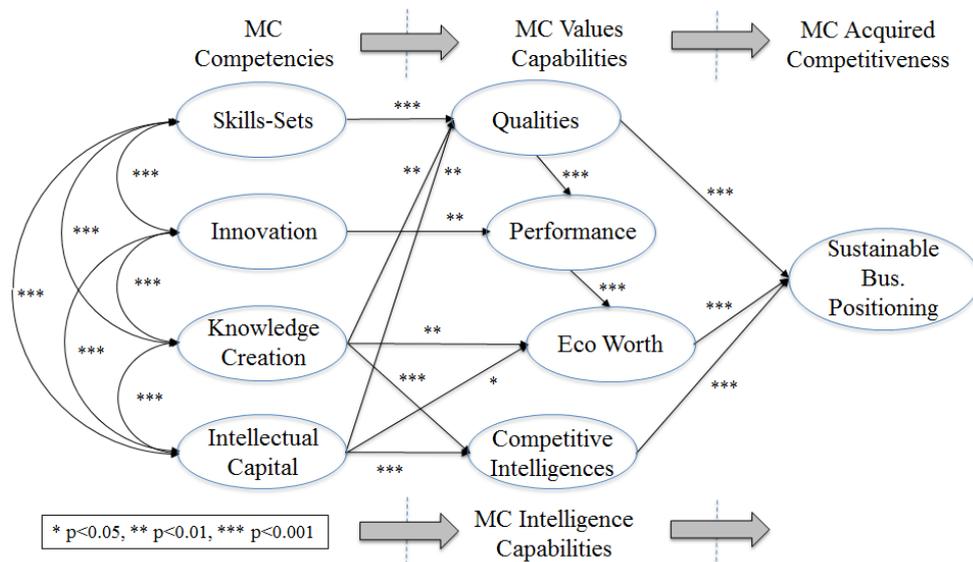


Figure 3: MCF-to-CF Sustainable Business Positioning Model

Table 3: MCF-to-CF Sustainable Business Positioning Model Fit Indices

FIT INDICES	CMIN	DF	CMIN/DF	P	Bollen-Stine Bootstrap	NFI	RFI	IFI	TLI	CFI	RMSEA
Study Values	28.82	17.00	1.70	0.04	0.26 (149/200 FITS)	0.96	0.92	0.99	0.97	0.98	0.08
Ex. Fit Stds	-	-	≥1; ≤3	>0.05	>0.05	≥0.95	≥0.90	≥0.95	≥0.95	≥0.95	≤0.08

Table 4: MCF-to-CF Sustainable Business Positioning Model Standardized β Weights

PATH BETWEEN CONSTRUCTS	β EST.	S.E.	C.R.	p
Qualities <-- Skills-Sets	0.30	0.09	3.43	***
Qualities <-- Knowledge Creation	0.23	0.08	2.81	0.005
Qualities <-- Intellectual Capital	0.26	0.09	2.91	0.004
Performance <-- Qualities	0.81	0.08	10.07	***
Performance <-- Innovation Additions	0.16	0.06	2.56	0.01
Competitive Intelligences <-- Knowledge Creation	0.39	0.09	4.33	***
Competitive Intelligences <-- Intellectual Capital	0.42	0.09	4.74	***
Eco Worth <-- Knowledge Creation	0.29	0.11	2.72	0.007
Eco Worth <-- Intellectual Capital	0.26	0.11	2.43	0.015
Eco Worth <-- Performance	0.47	0.09	5.20	***
Sustainable Bus. Positioning <-- Competitive Intelligences	0.30	0.08	3.86	***
Sustainable Bus. Positioning <-- Qualities	0.46	0.10	4.77	***
Sustainable Bus. Positioning <-- Eco Worth	0.25	0.07	3.41	***

DISCUSSION AND IMPLICATIONS OF MCF-TO-CF SUSTAINABLE BUSINESS POSITIONING MODEL

Theoretical Model And Applied Implications

Figure 3's MCF-to-CF Sustainable Business Positioning Model approach highlights the significant pathways a MCF can engage when assisting a CF towards a new sustainable business positioning. It differentiates three stages of MCF deliverance. Stage 1 encompasses pre-engagement. It sees the MCF continually developing its management consulting competencies. When the CF seeks a MCF's assistance the MCF draws on its relevant competencies to specifically deliver its new enhancements. Stage 2 then begins a MCF-to-CF transfer process. This brings new MCF ideas, approaches, innovations and skills-sets into the operations domain of the CF. These MCF-to-CF transfers are further exchanged, modified, and sorted across the consultancy. Over-time, Stage 2 is seen as delivering both a different set of CF values capabilities and CF competitive intelligence capabilities.

Stage 3 sees the results of these MCF-to-CF transfers. Here, against the MCF-CF discussions, an ongoing business solution is delivered. Where the CF deems the MCF-to-CF transfers provide useful deliverables capabilities (items of value and items of competitive intelligence), and so advances the CF beyond its former competitive business positioning, and then an ongoing CF sustainable (competitive) business positioning may result. Further, along with such positive outcomes, future MCF-to-CF consultancies may also be achievable. This creates further imperatives for the MCF to focus closely on delivering positive outcome solutions for the CF.

The MCF-to-CF Sustainable Business Positioning Model allows a MCF to understand how it may focus and best-deliver an enhanced CF sustainability (competitive) business positioning. Stage 1's four covarying model constructs being significantly-related (Cunningham, 2008; Hair et al., 2014), must be combined by the MCF into a relevant, overall competencies suite, directed specifically towards the CF. For example, the Figure 3 competencies of intellectual capital and knowledge creation jointly influence the MCF-to-CF competitive intelligence intermediary. Thus the MCF should optimize its intellectual and knowledge competencies as initiators of greater CF outcomes solutions and particularly its deliverable competitive intelligences skills-sets. Further, as each MCF competencies construct significantly influences the other, the MCF should continually formulate new ways to build their combined strengths. Thus, the MCF should research and maintain all four of its competencies and maintain these as its 'state-of-the-art' CF offerings.

Considering the four Figure 3 MCF-to-CF intermediaries (three utilitarian values deliverables, and the competitive intelligence deliverables), the strong intermediate values block displays an internal sequential pathway (qualities-to-performance-to-economic-worth). This suggests all three constructs must be conjointly 'optimized' in order to optimize the MC-to-CF values deliverance process. Also, regarding the Figure 3 intermediaries, it is noted that a suggested intermediate relational pathway between competitive intelligences and performance (Stefanikova & Masarova, 2014) is not significant in this study.

This study also implies where a MCF constantly 'optimizes' across all seven of its Figure 3 outcome-building constructs, it can deliver a 'best-case' CF sustainable (competitive) business positioning.

Practical Implications

The Table 5 MCF-to-CF 'standardized total effects' shows a progressive set of relative construct effects that ultimately deliver the CF sustainable (competitive) business positioning construct. This again indicates that MCFs can deliver CF business enhancements via multiple contributing pathways, and that each pathway can be specifically optimized (Cunningham, 2008). It suggests the success/failure of the MCF-to-CF relationship can be gauged via the net positive (or negative) changes in the CF sustainable (competitive) business positioning construct. For example, MCF intellectual capital and MC knowledge creation competencies are key pathway outcomes drivers of Figure 3, whilst MCF capabilities and innovation competencies are also significant, but of lesser importance in driving this model's outcomes.

Table 5: MCF-to-CF Sustainable Business Positioning Model Standardized Total Effects

TOTAL EFFECTS	Intellectual Capital	Skills-Sets	Knowledge Creation	Innovation Additions	Qualities	Performance	Eco Worth	Competitive Intelligences
Qualities	0.28	0.33	0.25	-	-	-	-	-
Performance	0.20	0.23	0.17	0.18	0.70	-	-	-
Eco Worth	0.30	0.10	0.31	0.08	0.29	0.42	-	-
Competitive Intelligences	0.42	-	0.38	-	-	-	-	-
Sustainable Bus. Positioning	0.31	0.16	0.28	0.02	0.47	0.11	0.27	0.28

It remains important to focus on (and optimize) the intermediate MCF-to-CF values of qualities being delivered and economic worth being generated, along with the competitive intelligences enlisted as these Table 5 constructs represent the key positive sustainable (competitive) business positioning drivers. Here, although performance is a lesser intermediary construct

contributor towards sustainability, it remains important as it does influence the economic worth construct. Further the qualities to performance to economic worth transitions should also be conjointly optimized.

Future Research Measurement Implications

In the future, where leading MCFs in India change the MCF-CF relationship by adding digital consultancy approaches (possibly encompassing: industry 4.0 advancements, robotics/cobotics/autonomous systems, 3D/4D printing operations, hype cycle innovations, real-time service value networks, levelled qualities improvements, software enablers, and/or augmented/virtual platform capabilities), then additional MCF competencies constructs – like ‘industry 5.0’ or ‘hype’ innovative skills-sets may also be required. Arguably, such additional and focused constructs may help produce an even stronger CF sustainable (competitive) business positioning.

Based on our literature investigations we suggest that future MCF-to-CF studies could include the hedonic values constructs of servicing and emotive satisfiers (Hamilton & Tee, 2016), and the intermediate competitive intelligences construct may also split by including an additional risk construct. Also, the sustainable (competitive) business positioning outcomes construct may sectioned to include CF satisfaction construct. Thus future MCF consultancies could possibly add additional CF diversity into their modelling.

However, although more construct items may fit the MCF-to-CF Sustainable Business Positioning Model, the three stage, time-lined pathways structure, as presented herein, is likely to remain. Future studies may also expose a logical pathway suggested by Stefanikova and Masarova, (2014) from competitive intelligences into the values deliverables suite.

Future Research Theoretical And Management Implications

Figure 3 suggests the MCF and the CF can be closer aligned when common management goals are cooperatively pursued. The three stage approach implies the model MCF-to-CF construct pathway transitions occurs over time, and in combination, and that these collectively help drive a recognizable CF sustainable business positioning.

To date no clear definition of Management Consulting Theory (MC Theory) exists - outside those provided by MCFs. By 2013, digital tracking and monitoring approaches were bringing changes into available MC competencies areas (Christensen et al., 2013). Today, MC can include multiple digital competencies areas across: cloud complemented collective intelligences, cobotics, augmented multidimensional realities, social media conectivities, multi-dimensional printing and block-chain systems. Such digital, autonomous intelligent inclusions offer continual re-modelling of MCF competencies, and so MCF's are continually able to improve their MCF-to-CF offerings, and then deliver ongoing, relevant, CF sustainable (competitive) business re-positioning opportunities.

Recently, the expansion of consulting services from just delivering strategy, into delivering a business strategy along with-full business implementation (Christensen et al., 2013; Hamilton, 2018) has shifted the scant, simplistic attempts to describe MC as a theory. Druckman, (2019) suggests consulting theory is currently merging and developing with practice. Hence, this study presents a new perspective concerning *Management Consulting Theory*, and now proposes that:

Management Consulting Theory offers measurable pathways towards generating an ongoing competitive CF. Management Consulting Theory enlists current MCF competencies, and uses these to help create a collaborative suite of optimizable MCF-to-CF values capabilities and competitive intelligences capabilities. When suitably focused, this engaged system of MCF competencies, and its CF-absorbed, MCF-to-CF capabilities enhancements, can jointly influence the promotion of a CF sustainable business positioning - ideally one that remains adaptive, and also promotes an ongoing CF sustainable (competitive) business positioning.

Thus, Management Consulting Theory is captured across the time-lined, three-Stage, MCF-to-CF Sustainable Business Positioning Model. Stage 1 introduces the MCF's competencies. Stage 2 then adds the active MC-to-CF consulting and enhancing deliverance phase. Stage 3 reflectively assesses the CF resultant sustainable (competitive) business positioning. Sometimes, Stage 1 and Stage 2 may not deliver optimal MCF-to-CF capabilities (Bower, 1982; Bessant & Rush, 1995). In such circumstances, additional constructs and/or refined construct items may offer further CF competitive advantages.

Thoughts And Limitations

Six limitations include being: a point-in-time study, a study involving nine constructs, an empirical study, conducted in India, supported by global members of the Institute of Management Consultants of India (and not all consulting firms), and developed from a small sample size bootstrap validated path model.

Researchers are invited to test this study's three stage Management Consulting Theory approach, and to deepen/extend its pathways modelling approach as a full structural equation model, and to refine the Management Consulting Theory proposed herein. Further, as MCF-to-CF values are likely time and place conditional, a longitudinal study is likely of use to display trends and to project future point-in-time (or progressive) rectifications.

As the MCF and the CF likely display different expectations, a gap analysis run before, during, and after the consultation may expose how a MCF may best re-align towards the CF.

Finally, where a MCF's developed knowledge systems remain intelligently-active within their neural networks, then real-time artificial intelligence (AI) responses to a CF's consultancy request can possibly be generated. Thus, MCFs with digital, real-time AI response competencies can likely outcompete rival, less-digital, non-real-time MCF solution providers.

CONCLUSION

This study's MCF-to-CF Sustainable Business Positioning Model suggests MCFs in India can astutely deploy their internally-developed, business-intelligence competences, and their competitive MCF-to-CF engagement capabilities as a knowledge and systems transference mechanism when assisting a CF towards enhancing its sustainable (competitive) business positioning. For example, the optimizing of qualities, and economic worth capabilities, and the wise engagement of competitive intelligences capabilities, then positively pushes the MCF-to-CF relationship towards enacting a stronger intermediate deliverance solution, and towards enhancing the CF's sustainable (competitive) business positioning. Thus the research question is positively answered.

This research also offers further clarification on: (1) a new (digitally-relevant) Management Consulting Theory approach, (2) MCF-to-CF competencies constructs (and their measurement items) - and their relative contributions as model initiators, (3) MCF constructs and their pathways systems, (4) model optimization possibilities, (5) MCF digitization of competencies constructs, and (6) a near-real-time integrated MCF-to-CF software platform solution capturing the MCFs digital age neural networks, external cloud datamining and AI-discovered item additions.

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Motives to Play a Mobile Location-Based Augmented-Reality Game of Non-Adopters: The Case of Pokémon Go

(Full Paper)

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ABSTRACT

The fast development of technologies such as Location-Based Service (LBS) and Augmented-Reality (AR) change the mobile game industry. Pokemon Go is a well-known location-based AR game. Few previous studies have studied the Pokemon Go's acceptance, but not with the non-adopters. The purpose of this paper is thus to apply the established theory, Technology Acceptance Theory (TAM), together with other potential determinants both the supporting and barrier factors to examine the intention to play the game of non-adopters. This work develops a research model including 6 factors: perceived enjoyment, subjective norms, privacy concerns, perceived ease of use, and perceived usefulness, and intention to play Pokemon Go and 12 hypotheses. Data were collected from 215 samples who were full-time students or full-time employees. Confirmatory factor analysis and structural equation modeling were applied to test the measurement model and proposed research model. Intention to play of non-players is directly enhanced by perceived enjoyment, perceived usefulness, and subjective norms. Privacy concerns indirectly influence intention to play via perceived usefulness. Subjective norms affect perceived ease of use, perceived enjoyment, and perceived usefulness respectively. Enjoyment and subjective norms also have indirect impacts on playing intention. The findings provide the guidelines to design for location-based AR game developers and the suggestions for the game providers. This study is one of few studies applying the TAM to location-based AR games and non-adopters. This work also incorporates meaningful factors that could explain the substantial changes in non-adopters' motives to play. Findings yield the contrary results in the context of Pokemon Go in Thailand, contributing to the literature of location-based AR games.

Keywords: Mobile gaming, augmented reality, location-based, Pokemon Go, technology acceptance theory, non-adopters, pre-adoption.

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INTRODUCTION

The development of mobile gaming technologies such as Augmented Reality (AR) and Location-Based Service (LBS) and the advance of wireless mobile networks enable opportunities for the mobile game industry (Ghazali, Mutum, & Woon, 2019). AR technology is a technique to show virtual content or objects superimposed upon the real world (Ghazali et al., 2019; Rauschnabel, Rossmann, & tom Dieck, 2017). In mobile games, it enables players to interact with physical environments during the gameplay (Jang & Liu, 2019). One of the new and disruptive markets is AR gaming (Lee, Chiang, & Hsiao, 2018; Rauschnabel et al., 2017). AR combines real and virtual objects in a real environment and runs them interactively to improve the user experience (Harborth & Pape, 2017; Rauschnabel et al., 2017; Shiau, Huang, & Cheng, 2017). LBS is another technology that applies location data from the Global Positioning System (GPS) to provide users various localized and personalized information services such as nearby places (Oh, Park, & Min, 2019). It changes gameplay from an indoor activity to encourage players to play outdoors, reinforce a player's sense of place, and create new social constructs for space, place, and territories (S. S. Wang & Hsieh, 2018). LBS offers convenience to users regarding customized information, but it can become a source of concern for new or experienced LBS users too (Oh et al., 2019). When AR is integrated with LBS, location-based AR games have the potential to immerse players into real environments by using their geolocation and mobility to fulfill local tasks (Jang & Liu, 2019; S. S. Wang & Hsieh, 2018). Unlike video games, location-based AR games enhance spatial exploration and interaction among players such as strangers or acquaintances (Jang & Liu, 2019; F.-Y. F. Wei & Wang, 2019).

Pokemon Go is a location-based AR game developed by Niantic for mobile devices. It has been adopted fastly by a vast number of players during the first two weeks after its launch in 2016 (Harborth & Pape, 2017; Jang & Liu, 2019; Shiau et al., 2017). It is also ranked as the most downloaded game app in Apple App Store and the Google Play Store in 2016 (Ghazali et al., 2019; Harborth & Pape, 2017; Lee et al., 2018; Shiau et al., 2017). Pokemon Go transforms places in the physical world such as landmarks into virtual places e.g. "PokeStops" and "Gyms". It is designed to encourage players to perform physical activities, for instance, catching creatures called "Pokemon" to complete the entries in the Pokedex or walking around the area to encounter randomly appearing Pokemon in real-world locations (Jang & Liu, 2019; Lee et al., 2018; Rauschnabel et al., 2017; S. S. Wang & Hsieh, 2018). However, public reactions to Pokemon Go are intense and mixed. Supporters mention the potential of the game to promote physical activities such as exercises, whereas critics raise fears of accidents or distractions when playing while driving and threats to users' privacy (Rauschnabel et al., 2017; F.-Y. F. Wei & Wang, 2019).

Recent AR games create worldwide interests in the opportunities of AR game type, but consumer research in this domain is scarce (Rauschnabel et al., 2017). Therefore, technology acceptance research is needed to foster an understanding of how AR could fit an individual's daily life (Harborth & Pape, 2017). The Technology Acceptance Model (TAM) is a model developed to explain an individual's acceptance of Information Technology (IT) in the information systems (IS) fields. It can also be applied to understand a user's motivation and purpose to accept entertainment technology such as online games and social games (Hasan, Linger, Chen, Lu, & Wang, 2016; Yoon, Duff, & Ryu, 2013). However, few studies have been extended the application of TAM to location-based AR games. Little research has explored technology acceptance factors of Pokemon Go (Harborth & Pape, 2017). Moreover, only TAM may not sufficient to explain usage behaviors in the LBS context. It is necessary to add factors suitable for this specific context (Oh et al., 2019).

Pokemon Go affects the cognition and emotions of users in various ways (Shiau et al., 2017). Yet, little attention has been paid to factors that might facilitate players' enjoyment (S. S. Wang & Hsieh, 2018). Perceived enjoyment has a large impact on online game users' intention/ behavior, but how to enhance users' enjoyment and use of games has not been investigated adequately, particularly the game enjoyment and the social perspective (Hasan et al., 2016). Both benefits, risks, and social influences should be evaluated from the view of AR game players. Established theories are limited in the application to AR games because most of them neglect the risks that consumers incorporate in their decision making such as privacy risks (Rauschnabel et al., 2017). Privacy concern also affects a user's intention to use LBS and location-based Social Networking Services (SNSs) (Zhou, 2013).

LBS has not been widely used by consumers (Zhou, 2013). Also, many of the existing AR studies have focused on the behavior of users interacting with the technology or user behavior at the early stage (Harborth & Pape, 2017; Jang & Liu, 2019), so most research is conducted with adopters (game players) rather than non-adopters. Focusing on AR game users, but not non-users is also one of the limitations mentioned in the previous AR study (Rauschnabel et al., 2017). Several Pokemon Go's players have been lost, showing the decline of the game after its one-year release (Jang & Liu, 2019; Lee et al., 2018). Thus, the success of existing mobile games such as Pokemon Go and future mobile games depend on engaging more (new) players (Ghazali et al., 2019). Besides, many AR studies have a common sample bias towards some user groups such as younger males with a high level of education or college students not across the general population (Harborth & Pape, 2017; Shiau et al., 2017).

Therefore, the research purposes of this study are as follows. First, this study investigates the Pokemon Go non-adopters (non-players)' intention to play the game and their perceptions (perceived usefulness and perceived ease of use) according to the established TAM theory. Second, this study adds a social influence factor (subjective norms) and a risk-related factor (privacy concerns) to the TAM and examines the direct and indirect effects of these factors on non-players' intention to play the game. Third, this study includes an emotional factor (perceived enjoyment), investigates its direct and indirect influence on non-players' intention to play the game, and explores the impact of subjective norms and perceived ease of use on the perceived enjoyment, which has been relatively rarely investigated in the previous studies. Also, to decrease the bias of sample characteristics, this study collects data from non-players both in studying age and working age. Few studies explore the Pokemon Go adoption in Southeast Asian environments such as Thailand. To my knowledge, thus, this research is the first to investigate the location-based AR game adoption and corresponding perception of non-adopters of Pokemon Go in Thailand. The research findings could contribute new knowledge to the scant literature related to location-based AR gaming from Thai mobile users' perspectives.

LITERATURE REVIEW

Rauschnabel et al. (2017) developed a comprehensive framework incorporating Uses and Gratification Theory (U>), technology acceptance, risk research, and flow theory to explain the drivers of gaming continuance and willingness to conduct in-app purchases. Findings showed that hedonic, emotional, and social benefits, and social norms drove consumer reactions, but physical risks impeded consumer reactions (Rauschnabel et al., 2017). Harborth and Pape (2017) explored the technology acceptance factors of Pokemon Go in Germany. Results pointed out that hedonic motivation (fun and pleasure) was the strongest driver of behavioral intention to play the game. Effort expectancy and habit yielded medium-sized effects on behavioral intention (Harborth & Pape, 2017). Shiau et al. (2017) conducted the study on the cognition and the consistency between emotions and the integration of Pokemon Go and reality using the Stimulus-Organism-Response (S-O-R) model. Findings indicated that information quality and virtual features significantly impacted the cognitive and emotional fit of users. The emotional fit had a significant effect on user satisfaction (Shiau et al., 2017). Kim, Lee, Cho, Kim, and Hwang (2018) explored the playing of Pokemon Go and the increase in players' physical activity. Results showed that self-efficacy (the will to exercise) insignificantly affected attitude towards the game and playing the game enhanced physical activity subconsciously and effectively (Kim et al., 2018). S. S. Wang and Hsieh (2018) examined the complexity of the link between Pokemon Go playing experience and players' affection towards their physical surroundings. Findings showed that perceived realism in terms

of simulational realism, freedom of choice, integrated presence, and perceptual pervasiveness positively related to game enjoyment. Co-presence significantly increased game enjoyment, while perceived crowding decreased game enjoyment (S. S. Wang & Hsieh, 2018). Lee et al. (2018) examined the drivers of Pokemon Go's stickiness in Taiwan. A conceptual model to investigate its antecedents was developed based on flow theory and satisfaction. Results pointed out that flow and satisfaction had strong and direct impacts on the game's stickiness. Age, gender, platform, game experience, and in-app expenses also significantly influenced the stickiness. Telepresence, challenge, perceived control, curiosity, and concentration directly affected the flow, whereas perceived currency and responsiveness directly caused players' satisfaction (Lee et al., 2018).

Jang and Liu (2019) collected data from the Pokemon Go's players to explore the effects of gratifications and other contributing factors on continuance intention to play the game. Findings showed that content gratification in terms of catching Pokemon, process gratification in terms of entertainment, game knowledge, and achievement enhanced players' continuance usage intention (Jang & Liu, 2019). Ghazali et al. (2019) tried to identify the antecedents of players' continuance intention to play Pokemon Go and their in-app purchases. Results from Malaysia showed that enjoyment, network externalities, community involvement, and the need-to-collect increased the players' continuance intention. Flow and nostalgia also indirectly drove their continuance intention, which finally influenced their purchase intention (Ghazali et al., 2019). K.-L. Hsiao, Lytras, and Chen (2019) investigated determinants of intention to purchase in Pokemon Go from players in Taiwan. The strong and direct predictors of in-app purchase intention were perceived value and satisfaction. Flow, design aesthetic, social self-expression, and good price directly impacted players' perceived value, while design aesthetic, reward, and the perceived value directly influenced their satisfaction (K.-L. Hsiao et al., 2019). F.-Y. F. Wei and Wang (2019) explored the relationships between the gaming activities of Pokemon Go's players, their willingness to communicate, and their likelihood to participate in exercises. Results pointed out that playing the game could increase the likelihood that players would engage in exercises. There was also a positive relationship between exercises during the gameplay and players' willingness to communicate with others (F.-Y. F. Wei & Wang, 2019). Shin (2019) explored the game-playing experience and its impacts on attitude towards AR games and satisfaction with the game. Findings showed that confirmation affected satisfaction together with hedonism and utility. Confirmation was driven by the quality factors that were immersion, flow, and presence (Shin, 2019).

HYPOTHESES AND RESEARCH MODEL

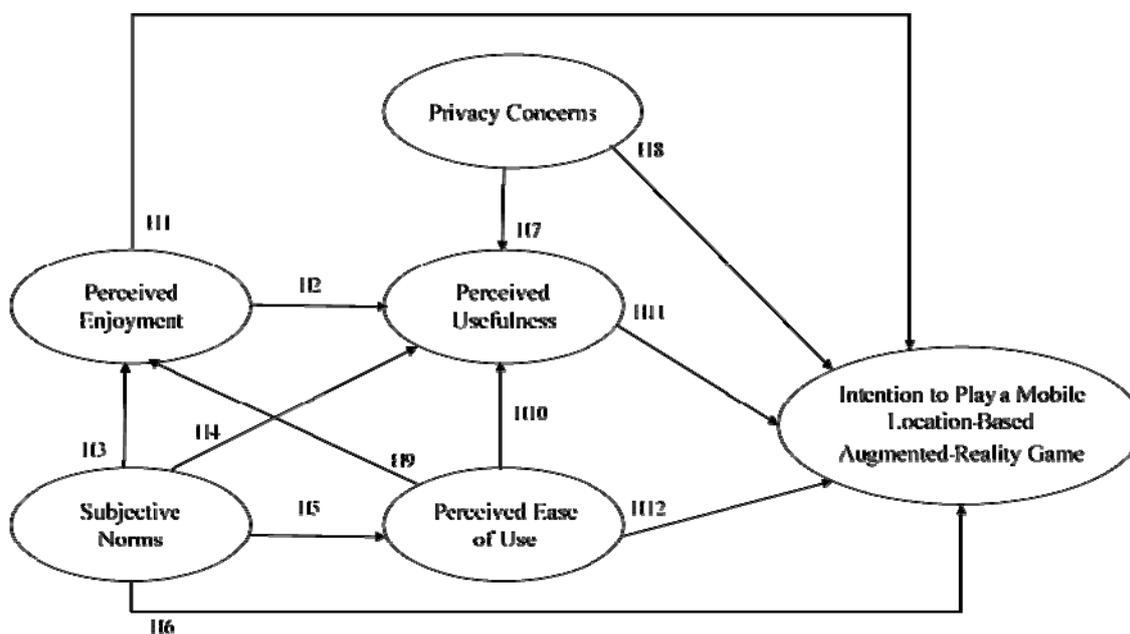


Figure 1: Research model

Figure 1 presents the research model and the proposed hypotheses.

Perceived Enjoyment

Enjoyment refers to the degree to which conducting an activity is perceived as fun and pleasurable in its rights (Ghazali et al., 2019; Hasan et al., 2016). Perceived enjoyment is an intrinsic motivation for online game playing (C.-C. Hsiao & Chiou, 2012; Park, Baek, Ohm, & Chang, 2014; Xu, 2014). Intrinsic motivation is the pleasure and entertainment of conducting a behavior (Hasan et al., 2016). Entertainment is a part of process motivation. It is a strong determinant of intention to play online games and players' intention to continue playing Pokemon Go (Jang & Liu, 2019). Perceived enjoyment is a type of hedonic value influencing a person's attitude and intention to use IT. Hedonic experience is a significant driver of attitude towards playing an online game, Massively Multiplayer Online Game (MMOG), and SNSs (Hasan et al., 2016; C.-C. Hsiao & Chiou, 2012; H.-H.

Lin, Wang, & Chou, 2012). Hedonic outcome expectations e.g. enjoyment from use experience significantly raise continuance intention to play online games (Chang, Liu, & Chen, 2014). Enjoyment is also a part of the flow, which happens when individuals are fully immersed in an activity and enjoying the experience, e.g. flow experience from social media usage (Lee et al., 2018). Flow significantly increase the confirmation of AR games (Shin, 2019). According to literature studies, perceived enjoyment is a strong predictor of users' behavioral intention in various online environments such as blog usage, users' engagement in m-commerce activities, online games (Ghazali et al., 2019) and a determinant of playing loyalty in the mobile game context (Lee et al., 2018). Perceived enjoyment significantly influences attitude towards the mobile game and online games, which significantly positively drive its intention/ actual behavior to play the games (Alzahrani, Mahmud, Ramayah, Alfarraj, & Alalwan, 2017; Hamari & Keronen, 2017; Liu & Li, 2011; Yoon et al., 2013). Perceived enjoyment of mobile gaming from students in South Africa is significantly related to their attitude towards mobile gaming that later significantly impacts students' mobile gaming continuance intention (Chinomona, 2013). It also significantly enhances attitude towards playing Mobile Broadband Wireless Access (MBWA) games (Ha, Yoon, & Choi, 2007). Perceived enjoyment has a significant positive effect on attitude towards mobile AR gameplay, which has a significant and positive effect on the intention to continue playing AR games (Rauschnabel et al., 2017). Perceived enjoyment has a significant and positive effect on a user's intention to use advanced mobile services (Verkasalo, López-Nicolás, Molina-Castillo, & Bouwman, 2010). It also increases users' intention to play games (Hamari & Keronen, 2017), physical tennis games (H.-H. Lin et al., 2012), online game (Yoon et al., 2013), social games (Hasan et al., 2016), Social Networking Games (SNG) (Park et al., 2014; Xu, 2014), and mobile games (Merikivi, Tuunainen, & Nguyen, 2017). Enjoyment significantly positively affects continuance intention to play Pokemon Go, which significantly positively impacts in-app purchase intention (Ghazali et al., 2019). Perceived enjoyment significantly enhances actual online game playing as well (Alzahrani et al., 2017). Thus, the following hypothesis is formulated:

Hypothesis 1. There is a positive relationship between perceived enjoyment and intention to play a mobile location-based augmented-reality game.

Emotional fit has a significant impact on game players' satisfaction (Shiau et al., 2017). The pleasure of using AR games significantly improve users' satisfaction (Shin, 2019). Perceived enjoyment has been found to be a significant determinant of various IT innovations such as mobile games. It is also an important driver of the use of hedonic systems (Liu & Li, 2011). Enjoyment and perceived usefulness are strongly related in various game contexts (Hamari & Keronen, 2017). Literature research found that perceived enjoyment as an intrinsic motivation has a positive impact on perceived usefulness as an extrinsic motivation (Liu & Li, 2011; S. S. Wang & Hsieh, 2018). Perceived enjoyment significantly increase perceived usefulness in mobile games under the mobile broadband wireless access environment (Ha et al., 2007). It significantly enlarges the perceived usefulness of mobile games as well (Liu & Li, 2011). Thus, the following hypothesis is offered:

Hypothesis 2. There is a positive relationship between perceived enjoyment and perceived usefulness.

Subjective Norms

Social factors profoundly affect users' behavior. Social influence is vital for shaping an individual's behavior. For example, social norms as one of the social influences affect players' attitude and intention in online games. Social influence is proposed as a moderator of the association between player-technology fit and enjoyment (Fang & Zhao, 2010). Social norms are also called as subjective norms or social influence (Verkasalo et al., 2010). Subjective norms are an influential person supporting or objecting behaviors, which impacts an individual's cognition (H.-Y. Lin & Chiang, 2013). Social norms have a significant and positive impact on perceived enjoyment in advanced mobile services (Verkasalo et al., 2010). Social interaction is a factor determining the enjoyment of players, which in turn significantly affects players' intention to play (Ghazali et al., 2019). Social supports in SNG help players fulfilling their needs and allowing good times to be shared with others. This could increase the players' enjoyment. Social interaction significantly positively impacts enjoyment received from Pokemon Go (Ghazali et al., 2019) and social games (Hasan et al., 2016). Accordingly, the following hypothesis is proposed:

Hypothesis 3. There is a positive relationship between subjective norms and perceived enjoyment.

An individual's behavior is driven by the extent to which he/ she believes other people's opinions that he/ she has to, will be, and able to use technology (Verkasalo et al., 2010). Social value significantly influences the overall perceived value in Pokemon Go (K.-L. Hsiao et al., 2019). According to literature research, social norms or subjective norms have a direct influence on perceived utility. In TAM-II, they are also assumed to have a direct impact on Perceived Usefulness (PU) and an indirect impact on people's intention via PU, for instance, in the context of advanced wireless Internet (H.-Y. Lin & Chiang, 2013; Verkasalo et al., 2010). Social norms are proposed to positively relate to perceived usefulness in online games (H.-Y. Lin & Chiang, 2013). They also significantly increase the perceived usefulness of advanced mobile services (Verkasalo et al., 2010) and online games (Fan, Gu, Suh, & Lee, 2012). A person's behavior and thinking are influenced by others such as

friends, family, and colleagues. An individual who has less knowledge and experience about specific technology would more heavily rely on people around them (Fan et al., 2012). According to the Diffusion of Innovation (DOI) theory, early majority adopters could be persuaded to use an innovation by providing them the evidence of the system's effectiveness and success stories from opinion leaders. Late majority adopters believe when many people have tried and used an innovation successfully, while laggards need the demonstration of innovation and pressure from their peers and other adopters (Stair & Reynolds, 2017). Hence, the following hypotheses are examined:

Hypothesis 4. There is a positive relationship between subjective norms and perceived usefulness.

Hypothesis 5. There is a positive relationship between subjective norms and perceived ease of use.

According to the Theory of Reasoned Action (TRA), a person's intention is influenced by his/ her subjective norms and attitude (Harborth & Pape, 2017; Hasan et al., 2016). A large number of literature studies confirm that social norms positively affect the use of technology and media (Rauschnabel et al., 2017). Most Pokemon Go players (74 percent) prefer playing the game with others such as friends or acquaintances more than playing alone, so social gratification of a mobile AR game is proposed to positively impact players' intention to continue playing the game (Jang & Liu, 2019). Social norms are proposed to have a positive effect on behavioral intention in the context of Pokemon Go (Harborth & Pape, 2017). Social norms have significant influences on intention to use LBS (Mao & Zhang, 2014; Zhou, 2012), behavioral intention to play online games (H.-Y. Lin & Chiang, 2013), user's intention to play online games (Fan et al., 2012), continuance intention to play online games (Chang et al., 2014), continuance intention to play SNG (Xu, 2014), user's intention to play social games (Hasan et al., 2016), intention to continue playing Pokemon Go, in-app purchase intention (Rauschnabel et al., 2017), mobile SNS continuance usage in China (Zhou & Li, 2014), actual online game playing (Alzahrani et al., 2017). Therefore, the following hypothesis is offered:

Hypothesis 6. There is a positive relationship between subjective norms and intention to play a mobile location-based augmented-reality game.

Privacy Concerns

The perceived risk significantly negatively associates with the perceived usefulness of LBS (Oh et al., 2019). Privacy risk is the potential losses from personal information disclosure by third parties without users' knowledge. Privacy risk could affect perceived usefulness and lower users' expectations toward future outcomes, decreasing perceived utility. Literature research indicates that perceived risk decreases the performance expectancy of mobile banking. Privacy risk significantly negatively impacts the perceived usefulness of LBS (Zhou, 2013). Perceived privacy in terms of collection, error, unauthorized second use, and improper access is related to the perceived usefulness of LBS (Junglas & Spitzmuller, 2005). Many mobile and online games force their players to disclose personal information before gameplay and collect meta-information such as the IP address of players. Location-based mobile games are susceptible to fear of privacy risks. Accessing personal and meta-information could induce privacy concerns among users and negatively affect the value of games (Hamari, Malik, Koski, & Johri, 2019). The majority of Internet users (more than 50 percent) express their concerns with information privacy (Mousavizadeh & Kim, 2015). Privacy concerns represent an individual's perception of how his/ her personal information is being used. Privacy concerns have an indirect effect on user behavior through perceived usefulness as a mediator (Ofori, Larbi-Siaw, Fianu, Gladjah, & Boateng, 2016). Based on the preceding supports, the following hypothesis is presented:

Hypothesis 7. There is a negative relationship between privacy concerns and perceived usefulness.

Privacy risk is proposed to negatively affect attitude towards playing Pokemon Go (Rauschnabel et al., 2017). Privacy risk significantly negatively associated with the continuous usage intention of LBS because disclosing personal information by LBS could bring users uncertainty and potential losses (Zhou, 2013). Literature studies indicate that privacy concerns are one of the biggest obstacles to Internet use (Zhao, Lu, & Gupta, 2012). Privacy concerns are proposed to be negatively related to usage intention of LBS (Zhou, 2012) and the reuse intention of Pokemon Go (Hamari et al., 2019). Specific Concerns for Information Privacy (CFIP), general CFIP, and perceived privacy risk are proposed to have a negative impact on the intention to provide information for transactions (Li, 2011). Concerns for information privacy is proposed to negatively affect intention to use LBS (Mao & Zhang, 2014). Privacy concerns significantly negatively link to disclose location-related information in LBS usage (Zhao et al., 2012), continuance usage of mobile SNS (Zhou & Li, 2014), and continuance usage of LBS (Zhou, 2016). Hence, the following hypothesis is given:

Hypothesis 8. There is a negative relationship between privacy concerns and the intention to play a mobile location-based augmented-reality game.

Perceived Usefulness And Perceived Ease Of Use

Perceived ease of use is the degree that a user of a specific technology feels free from engaging in mental and physical efforts. Literature research supports the positive relationship between perceived ease of use and enjoyment such as in the contexts of mobile services, mobile games, and Internet services. There is also a positive association between intrinsic motivation i.e. enjoyment and perceived ease of use in the self-efficacy theory (Park et al., 2014). Self-efficacy indirectly affects perceived enjoyment through perceived ease of use (L. Wei & Zhang, 2008). Perceived ease of use is strongly related to the enjoyment of games (Hamari & Keronen, 2017). Perceived ease of use significantly positively impacts perceived enjoyment of the Internet (L. Wei & Zhang, 2008), Mobile Social Networking Games (M-SNGs) (Park et al., 2014), mobile games (Ha et al., 2007; Merikivi et al., 2017), and Pokemon Go (Kim et al., 2018). Mobile games, which are perceived as difficult to use, could make a user's time does not pass enjoyable (Ha et al., 2007; Merikivi et al., 2017). Students feel less enjoyment if using the Internet is too difficult for them too (L. Wei & Zhang, 2008). Moreover, perceived ease of use has a positive influence on perceived enjoyment in hedonic systems and physical tennis games (H.-H. Lin et al., 2012). Therefore, the following hypothesis is developed:

Hypothesis 9. There is a positive relationship between perceived ease of use and perceived enjoyment.

Attitude towards playing Pokemon Go and behavioral intention to continue playing the game and conduct in-app purchases are expected to be driven by benefits such as hedonic benefit and emotional benefit (Rauschnabel et al., 2017). Utilitarian outcome expectations significantly increase continuance intention to play online games (Chang et al., 2014). Utility while using AR games significantly enhances players' satisfaction (Shin, 2019). Users with high cognitive absorption may agree with the positive association between technology usefulness and willingness to engage in new technology (Chang et al., 2014). Perceived usefulness significantly positively affects attitude towards playing online games, which significantly positively impacts the intention to play online games (Yoon et al., 2013). Playing intention of games such as online games is significantly driven by perceived usefulness (Fan et al., 2012; Hamari & Keronen, 2017; H.-Y. Lin & Chiang, 2013). Perceived usefulness significantly positively affects intention to use LBS (Mao & Zhang, 2014), continuance usage of LBS (Zhou, 2013), and LBS app connectedness (Oh et al., 2019). Students' perceived mobile games easy to play are significantly positively related to their continuance intention to play mobile games in South Africa (Chinomona, 2013). Perceived ease of use is proposed to positively influence attitude towards playing online games (Yoon et al., 2013). Perceived ease of use of M-SNGs and mobile game significantly raise users' attitude towards the games, which later significantly enhance users' intention to use the games (Liu & Li, 2011; Park et al., 2014). Perceived ease of use directly influences behavioral intention to play online games (Fan et al., 2012; H.-Y. Lin & Chiang, 2013) and location-based services (Mao & Zhang, 2014). According to TAM, behavioral intention is influenced by an individual's attitude towards using technology, perceived usefulness, and perceived ease of use. Subjective perceptions regarding a system's ease of use directly influence a person's overall attitude and perceived usefulness as well (Harborth & Pape, 2017). Perceived ease of use is proposed to be a positive driver of the perceived usefulness of mobile games (Liu & Li, 2011) and online games (Yoon et al., 2013). Perceived ease of use is significantly positively related to perceived usefulness of online games (Fan et al., 2012; H.-Y. Lin & Chiang, 2013), mobile games under Mobile Broadband Wireless Access (MBWA) environment (Ha et al., 2007), and LBS application (Oh et al., 2019). Perceived ease of use has a high path coefficient between it and perceived usefulness (Hamari & Keronen, 2017). As such, the following hypotheses are posited:

Hypothesis 10. There is a positive relationship between perceived ease of use and perceived usefulness.

Hypothesis 11. There is a positive relationship between perceived usefulness and intention to play a mobile location-based augmented-reality game.

Hypothesis 12. There is a positive relationship between perceived ease of use and intention to play a mobile location-based augmented-reality game.

METHOD

Research Instrument Development

A survey was conducted to test the proposed model since the survey method is best for obtaining personal and social facts, beliefs and attitudes, and could expand the application of research findings (Kerlinger, 1973). An online questionnaire, written in Thai, was developed to collect data. The questionnaire contained the following sections: a section describing about the target samples and the definitions of LBSs and the description about Pokémon Go, a section exploring game perceptions i.e. perceived enjoyment, subjective norms, perceived usefulness, and perceived ease of use, a section investigating privacy concerns, and a section about participants' demographic characteristics, the frequency of using mobile Internet, and game preferences. Measurement items were adapted from previous research to measure the constructs to enhance the validity of the construct measures. Some items were reworded to fit the mobile location-based AR game (Pokemon Go) context. The example of measurement items and sources for each construct were described in Table 1. All items were assessed using a five-point

Likert scale. Generally, other variables such as age, gender, education, and so on were measured using a single-item measure. According to the initial assessment of the measurement model e.g. factor analysis, two items were used to measure each construct. Ultimately, twelve items were retained for further analysis with good internal consistency. All factors' Cronbach's α were ranging from 0.857 to 0.970.

Table 1: Construct and sources.

Construct	Example Item	Sources
Perceived enjoyment	Please rate your perceptions regarding these sentences (1 – strongly disagreed 5 – strongly agreed): I would have fun playing this game.	(Chong, 2013; H. -Y. Wang, Liao, & Yang, 2013)
Subjective norms	Please rate your perceptions regarding these sentences (1 – strongly disagreed 5 – strongly agreed): People or peers important to me would support my play of this game.	(Hsu, Chang, Lin, & Lin, 2015; Pihlström, 2008; H. -Y. Wang et al. , 2013)
Privacy concerns	In general, please indicate your concerns regarding that your personal information can become available to someone without your knowledge. (1 - not at all concerned 5 - extremely concerned)	(Ho, Chen, & Luo, 2015; Krasnova & Veltri, 2010)
Perceived usefulness	Please rate your perceptions regarding these sentences (1 – strongly disagreed 5 – strongly agreed): I would find this game useful in my life.	(Chong, 2013; Oghuma, Libaque-Saenz, Wong, & Chang, 2016; H. -Y. Wang et al., 2013)
Perceived ease of use	Please rate your perceptions regarding these sentences (1 – strongly disagreed 5 – strongly agreed): I would find it easy to control this game to do what I want it to do, not require a lot of effort.	(Huang & Liao, 2015; Yongqiang Sun, Wang, Shen, & Zhang, 2015; YY Sun, Zhao, Jia, & Zheng, 2015)
Intention to play	Please rate your perceptions regarding these sentences (1 – strongly disagreed 5 – strongly agreed): I have the intention to play this game in the future.	(Ho et al., 2015; Pihlström, 2008; Turel, Serenko, & Bontis, 2010)

Data Collection And Samples

This study is a sub-project of a project titled POKEMON GO. The data were gathered using a non-probability quota sampling method using an online survey. The online survey was deemed appropriate to access the target samples because of the nature of online mobile games (Ghazali et al., 2019). As this study concerns the perceptions of non-adopters, the targeted respondents were current non-players of Pokemon Go. Harborth and Pape (2017) emphasize that several AR studies include only students as participants or young males with a high level of education. This could limit the validity of the findings and generate drawbacks. To decrease a common sample bias of AR studies in the literature and to increase the generalization of findings to various non-adopter groups, this study collected data from both full-time students (age less than or equal 25 years old) and full-time employees (age more than or equal 20 years old) who did not play Pokémon Go. The online survey was distributed to participants by the research assistant team. A total of 215 questionnaires were collected (108 full-time students and 107 full-time employees as non-adopters) and were ready for further analysis. The sample size was exceeded than the rule of thumb of 5 respondents per variable (Bentler & Chou, 1987).

RESULTS

Demographics Of The Respondents

Descriptive statistics of respondents are presented in Table 2. For gender breakdown, 43.3 percent of the respondents were male and 56.7 percent were female. For the studying-age non-players, 46.3 percent of them were male, whereas 53.7 of them were female. For the working-age non-players, 40.2 percent of them were male, while 59.8 percent of them were female. The average age of all respondents was 26 years old. The average age of the non-playing student group was 21 and the average age of the non-playing employee group was 31. The gender breakdown was different from the study of Ghazali et al. (2019), Shiau et al. (2017), and Lee et al. (2018) regarding Pokemon Go in terms of the proportion of males and females, but the respondents' ages were quite similar to the study of Ghazali et al. (2019) and Lee et al. (2018) in terms of overall samples and the study of (Shiau et al., 2017) in terms of non-player student group. The distribution of gender in this study was also conformed to the study of Harborth and Pape (2017) regarding Pokemon Go, which the players in their study were mainly women. In the study of Harborth and Pape (2017), the age distribution of players was quite skewed, with more younger users, but the age of respondents was quite distributed from studying age to working age in this study. All respondents in this study

mainly received or studied in the Bachelor's degree (74.9 percent of all non-players, 93.5 percent of studying-age non-players, and 56.1 percent of working-age non-players, conforming to the study of Lee et al. (2018) particularly the student group. Non-players used mobile Internet normally 8 hours per day and averagely 6-7 days per week. The most favorite game type that overall non-players playing was Action/ Adventure/ Arcade (40.9 percent). Top-three game types played by full-time students were Action/ Adventure/ Arcade, Educational, and Role Playing/ Simulation/ Strategy respectively, whereas top-three game types played by full-time employees were Action/ Adventure/ Arcade, Role Playing/ Simulation/ Strategy, and Sports/ Racing.

Table 2: Participants demographics.

Demographic Characteristics	Full-time Students	Full-time Employees	All Participants
	N (%)	N (%)	N (%)
Gender			
Male	50 (46.3%)	43 (40.2%)	93 (43.3%)
Female	58 (53.7%)	64 (59.8%)	122 (56.7%)
Total	108	107	215
Average Age	21	31	26
Education (Studying/ Received)			
Lower than Bachelor Degree	7 (6.5%)	7 (6.5%)	14 (6.5%)
Bachelor Degree	101 (93.5%)	60 (56.1%)	161 (74.9%)
Master Degree	0 (0.0%)	39 (36.4%)	39 (18.1%)
Doctoral Degree	0 (0.0%)	1 (0.9%)	1 (0.5%)
Total			
Average Amount of Using Mobile Internet (hours/ day)	8	8	8
Average amount of Using Mobile Internet (days/ week)	6	7	7
Other Game Types Playing			
Action/ Adventure/ Arcade	40 (37.0%)	48 (44.9%)	88 (40.9%)
Board/ Card/ Casino	7 (6.5%)	21 (19.6%)	28 (13.0%)
Educational	38 (35.2%)	20 (18.7%)	58 (27.0%)
Music	12 (11.1%)	15 (14.0%)	27 (12.6%)
Sports/ Racing	32 (29.6%)	26 (24.3%)	58 (27.0%)
Role Playing/ Simulation/ Strategy	33 (30.6%)	38 (35.5%)	71 (33.0%)
Trivia/ Word/ Puzzle	31 (28.7%)	24 (22.4%)	55 (25.6%)
Total	108 (100.0%)	107 (100.0%)	215 (100.0%)

Confirmatory Factor Analysis

Table 4 presents the means and standard deviations of the constructs. Privacy concerns had the highest mean, whereas perceived usefulness had the lowest standard deviation. Because the respondents were non-adopters, intention to play had the lowest mean. In terms of supporting factors, perceived ease of use, subjective norms, and perceived enjoyment had greater means and higher standard deviations, compared to perceived usefulness. This showed that non-players had a lower interest to play the game, although they perceived that the game was easy to play. Non-players were concerned about privacy as well. The data were firstly processed by evaluating internal consistency, reliability, convergent validity, and discriminant validity and conducting a confirmatory factor analysis to validate the measurement model.

In terms of internal consistency and reliability, Internal Consistency Reliability (ICR) (measurements which were Cronbach's α and the Composite Reliability (CR) were assessed. The value of both measurements should be above the acceptable reliability threshold of 0.7 and 0.8, satisfying ICR (Fornell & Larcker, 1981; Harborth & Pape, 2017). As shown in Table 3, Cronbach's alpha values and CR values of all constructs were above the acceptable thresholds. Considering convergent validity, it showed the effectiveness of questionnaire items that reflected corresponding factors (Lee et al., 2018). Factor loadings of all indicators were greater than 0.8, exceeding the ideal threshold of 0.7 (Fornell & Larcker, 1981; Hair & Tatham, 1998; Shiau et al., 2017). The Average Variance Extracted (AVE) of all constructs were ranging from 0.751 to 0.942. They had higher values than the acceptable threshold of 0.5, which indicated that the construct explains at least half of the variance of the indicators, ensuring convergent validity (Fornell & Larcker, 1981; Harborth & Pape, 2017; Lee et al., 2018). Discriminant validity was evaluated by the approach that the square root of the AVE of a single construct should be larger than the correlation with other constructs (Fornell & Larcker, 1981). Table 3 showed that all values of the square root of the AVE on the diagonal were larger than the correlations with other constructs, demonstrating discriminant validity. Confirmatory factor analysis was applied to test the measurement model to assess the model fit of the research data. The following fit indicators were explored: the ratio of Chi-square statistics to degree of freedom (χ^2/df), Goodness of Fit (GFI), Adjusted Goodness of Fit (AGFI), Normed Fit Index (NFI), Non-Normed Fit Index (NNFI), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Standardized (Root Mean Square Residual) (SRMR). Table 5 presented the test results, which demonstrated that all fit indices exceeded the suggested thresholds. Therefore, it could be concluded that the model fitted the data well.

Table 3: Results of the confirmatory factor analysis.

Construct	Average Variance Extracted	Composite Reliability	Cronbach's Alpha
Perceived enjoyment	0.877	0.934	0.932
Subjective norms	0.769	0.869	0.862
Privacy concerns	0.916	0.956	0.954
Perceived usefulness	0.768	0.869	0.866
Perceived ease of use	0.751	0.858	0.857
Intention to play	0.942	0.970	0.970

Table 4: Correlation matrix for latent constructs.

Construct	Mean, SD	ENJOY	SN	PRIVACY	PU	PEOU	INT_PLAY
Perceived enjoyment	2.27, 1.16	0.936					
Subjective norms	2.50, 1.23	0.543	0.877				
Privacy concerns	3.42, 1.33	0.167	0.326	0.957			
Perceived usefulness	1.96, 0.94	0.690	0.511	0.039	0.876		
Perceived ease of use	2.98, 1.14	0.616	0.566	0.306	0.531	0.867	
Intention to play	1.72, 1.05	0.685	0.567	0.132	0.672	0.383	0.971

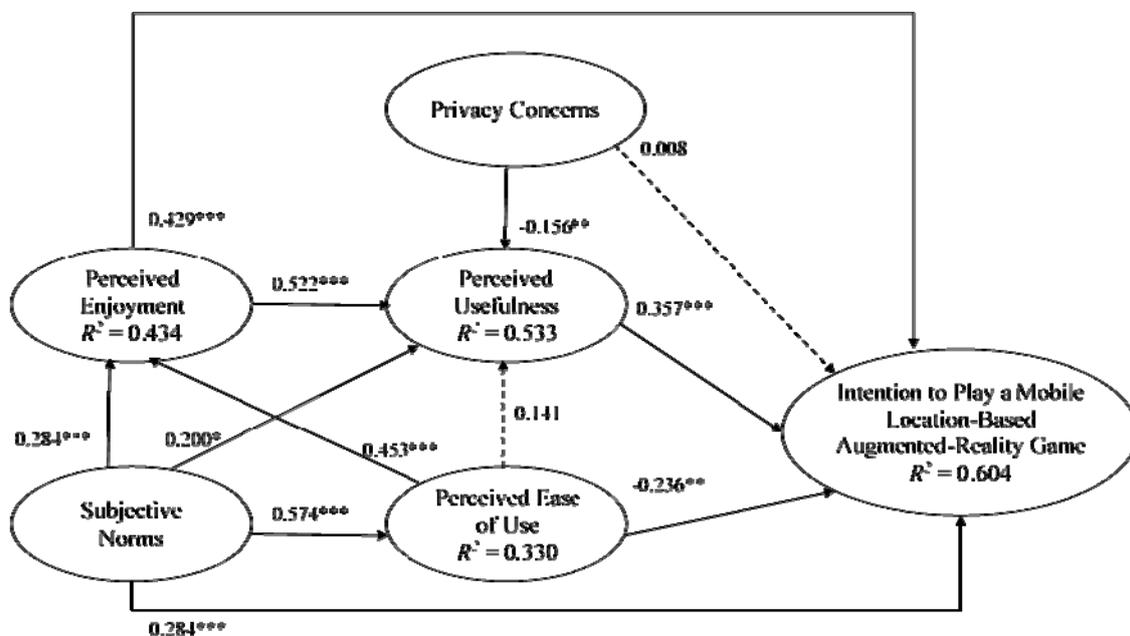
Fit Measure	Good Fit Criteria (Parry, 2017; Schermelleh-Engel, Moosbrugger, & Müller, 2003)	Indicators Confirmatory factor analysis	Indicators Structural equation modeling
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χ^2/df	$\chi^2/df \leq 2$	1.360	1.414
Goodness of Fit (GFI)	GFI ≥ 0.95	0.962	0.958
Adjusted Goodness of Fit (AGFI)	AGFI ≥ 0.90	0.923	0.920
Normed Fit Index (NFI)	NFI ≥ 0.95	0.976	0.974
Non-Normed Fit Index (NNFI)	NNFI ≥ 0.97	0.989	0.988
Comparative Fit Index (CFI)	CFI ≥ 0.97	0.994	0.992
Root Mean Square Error of Approximation (RMSEA)	RMSEA ≤ 0.05	0.041	0.044
Standardized Root Mean Square Residual (SRMR)	SRMR ≤ 0.05	0.0197	0.0283

Table 5: CFA and SEM: Model fit.

The values in the diagonal row are the square roots of the average variance extracted, and the others are the correlation between constructs. The sample size is 215.

The Structural Equation Model Analysis



Note: *** Significant at $p < 0.001$ level, ** Significant at $p < 0.01$ level, * Significant at $p < 0.05$ level.

Figure 2: Structural path coefficients.

The next step was to explore the structural model fit by path analysis with latent constructs. The analysis results and the fit indices of the Structural Equation Modeling (SEM) were shown in Table 5. Ten of the twelve paths in the research model were significant, but nine of ten hypotheses were supported, as shown in Figure 2. The model accounted for 60.4, 53.3, 33.0, and 43.4 percent of the variances in intention to play a mobile location-based AR game, perceived usefulness, perceived ease of use, and perceived enjoyment orderly. All factors directly or indirectly contributed significant roles in persuading non-players to play a location-based AR game in the future. The coefficients of the model showed the positive relationships between non-players' perceived enjoyment for the game and their intention to play Pokemon Go in the future (H1: $\beta = 0.429$, $p < 0.001$) and perceived usefulness of Pokemon Go (H2: $\beta = 0.522$, $p < 0.001$). The model confirmed the importance of subjective norms by showing positive and significant relationships between subjective norms and perceived enjoyment (H3: $\beta = 0.284$, $p < 0.001$), perceived usefulness (H4: $\beta = 0.200$, $p < 0.05$), perceived ease of use (H5: $\beta = 0.574$, $p < 0.001$), and intention to play (H6: $\beta = 0.284$, $p < 0.001$). Moreover, a negative and significant relationship was found between privacy concerns and perceived usefulness (H7: $\beta = -0.156$, $p < 0.001$), but no significant relationship between privacy concerns and intention to play (H8). The model supported a positive relationship between perceived ease of use and perceived enjoyment (H9: $\beta = 0.453$, $p < 0.001$) and showed a negative relationship between perceived ease of use and intention to use (H12: $\beta = -0.236$, $p < 0.01$), but

no significant relationship between perceived ease of use and perceived usefulness (H10). Finally, a significant and positive relationship between perceived usefulness and intention to play the game in the future emerged (H11: $\beta = 0.357, p < 0.001$).

DISCUSSION

Table 6 presents a summary of the research results. Nine of twelve hypotheses are supported. The results harmonize with the assertions in the *Hypotheses and Research Model* section. However, this study yields different findings from some previous studies, presenting new knowledge in the context of location-based AR games in Thailand. For example, game enjoyment insignificantly associates with place attachment in the study of S. S. Wang and Hsieh (2018), but in this study perceived enjoyment plays important roles for both perceived usefulness and intention to play. This conforms to the study of Hamari and Keronen (2017) indicating that enjoyment is more significant for hedonic games rather than utilitarian games. Social influence insignificantly drives behavioral intention in the study of (Harborth & Pape, 2017) regarding Pokemon Go in Germany and the study of Zhang, Zhao, and Tan (2010) relating to online games, but subjective norms are fully supported their direct and indirect effects on intention to play Pokemon Go in this study. The effect of perceived usefulness on playing intention in this study is quite similar to the study of Hamari and Keronen (2017). Although perceived usefulness does not directly, but indirectly impact intention to play in other game studies such as online games, mobile games (Liu & Li, 2011; Yoon et al., 2013), perceived usefulness directly affects intention to play of Pokemon Go's non-adopters in Thailand. The insignificant relationship between perceived ease of use to perceived usefulness and the negative relationship between perceived ease of use an intention to play could be explain by the insignificant relationships between ease of use and usefulness and perceived ease of use and attitude to play in the study of Liu and Li (2011) and Yoon et al. (2013), the lower correlations or connections of perceived ease of use and players' attitude and perceived ease of use and perceived usefulness in hedonic games compared to utilitarian games (Hamari & Keronen, 2017), the insignificant relationship between ease of use and LBS app connectedness (Oh et al., 2019), and the insignificant relationship between perceived ease of use and attitude towards playing an online game (Zhang et al., 2010). The insignificant link between privacy concerns and intention to play a location-based AR game could be explained by the insignificant relationships of privacy concern and LBS satisfaction (Zhou, 2016), intention to use LBS (Mao & Zhang, 2014; Zhou, 2012), reuse intention and in-app purchase intention of Pokemon Go (Hamari et al., 2019).

Table 6: Summary of testing of hypotheses

Hypothesis	Supported/ Not supported
Hypothesis 1. There is a positive relationship between perceived enjoyment and intention to play a mobile location-based augmented-reality game.	Supported
Hypothesis 2. There is a positive relationship between perceived enjoyment and perceived usefulness.	Supported
Hypothesis 3. There is a positive relationship between subjective norms and perceived enjoyment.	Supported
Hypothesis 4. There is a positive relationship between subjective norms and perceived usefulness.	Supported
Hypothesis 5. There is a positive relationship between subjective norms and perceived ease of use.	Supported
Hypothesis 6. There is a positive relationship between subjective norms and intention to play a mobile location-based augmented-reality game.	Supported
Hypothesis 7. There is a negative relationship between privacy concerns and perceived usefulness.	Supported
Hypothesis 8. There is a negative relationship between privacy concerns and intention to play a mobile location-based augmented-reality game.	Not supported
Hypothesis 9. There is a positive relationship between perceived ease of use and perceived enjoyment.	Supported

Hypothesis	Supported/ Not supported
Hypothesis 10. There is a positive relationship between perceived ease of use and perceived usefulness.	Not supported
Hypothesis 11. There is a positive relationship between perceived usefulness and intention to play a mobile location-based augmented-reality game.	Supported
Hypothesis 12. There is a positive relationship between perceived ease of use and intention to play a mobile location-based augmented-reality game.	Not supported (significant but in a negative way)

IMPLICATIONS

From the theoretical aspects, this study contributes to the location-based AR game studies in several ways. First, it provides empirical support for an integrated model of the TAM constructs, TRA construct, and other motivational and barrier factors to understand the determinants of non-players' behavioral intention. One game type may be different from others such as social games and other online games (Hasan et al., 2016). Not so much studies in the location-based AR game literature incorporates TAM factors to study non-adopters' behavioral intention. Second, this study fulfills the gaming literature by exploring different sample groups i.e. non-players, studying-age and working-age non-adopters, which could improve literature knowledge about location-based AR games. Third, this study explores the relationships that have not been so much explored in the location-based AR games that are the relationships between enjoyment and usefulness, subjective norms and perceived enjoyment and perceived ease of use, privacy concerns and perceived usefulness, and perceived ease of use and perceived enjoyment. The empirical test shows the new roles that perceived enjoyment, subjective norms, privacy concerns, and perceived ease of use have in determining the intention to join games in the future. Exploring antecedents of perceived enjoyment helps to deeply understand the critical factors that enhance hedonic value and subjective norms are emphasized to be included when examining users' intentions (Hasan et al., 2016). This study shows the importance of these relationships in the context of Pokemon Go, which could be further applied to other game contexts. Fourth, this study presents the contrary results from the previous studies and the theory. In the context of Pokemon Go's non-adopters in Thailand, privacy concerns have only an indirect impact on intention instead of a direct impact. Due to the familiarity of mobile apps and the ease of use of mobile games, this study reveals a negative relationship between perceived ease of use and non-adopters' playing intention and an insignificant relationship between perceived ease of use and usefulness, which is consistent with some previous studies regarding mobile/ online games. Last, although Pokemon Go is in the popular game types that both full-time students and full-time employees playing, they may not adopt the game, indicating the need to understand non-adopters more and how to convert them to be adopters.

This research has several practical implications for future location-based AR game developers and the providers of location-based AR games, in creating new and pleasant game experiences and driving non-players' acceptance of these location-based AR games. Findings indicate that non-players will have the intention to play location-based AR games e.g. Pokemon Go in the future if they believe that they would have fun playing the game. If non-players perceive that the game could fulfill their needs or the game is useful for their lives, they may be will willing to play the game in the future. Non-players' intention to play the game will be increased if people around them support them to play the game or if they perceive that playing the game will make a good impression for others as well. Non-adopters' perceived usefulness could be increased by perceived enjoyment and the opinions of other people surrounding them. If non-adopters find that it is easy to control the game and play the game using less effort and other people persuade their gameplay, they will perceive high enjoyment from the game. Their beliefs about the game enjoyment could lead to the increase of perceived usefulness of other non-adopters close to them if they communicate their gratification. Moreover, the perception that the features such as map and AR in the game are clear and understandable could be raised by the peers of non-players. However, intention to play the game of non-players could be impeded by their concerns regarding that their personal information can become available to someone without their knowledge or used in a way that they do not foresee. Future location-based AR game developers should build the location-based AR games to include suitable game dynamics and mechanics such as collection, points, leaderboard, achievements and so on (González & Area, 2013) to increase perceived enjoyment for potential players. These game mechanics could help to make the game not to easy to win, but developers should maintain the interactions between users and game to be easy, to enhance the game enjoyment. Moreover, the game should utilize the distinctive points of LBS and AR technologies, for instance, nearby friends or simulating some online activities topping up on offline environments, to improve users' perceived enjoyment. Game developers should not collect unnecessary information from players and clearly announce the collected data, usage purposes, and the details of data transfer to other parties to users, to lower privacy concerns of potential adopters. Benefits such as social

benefits, emotional benefits, functional benefits, benefits for health, and so on should be added into the game since its design phase because potential users should feel that the game is useful, will complete their needs, or provide some benefits for their lives. The game should be designed to support social features such as playing with new friends getting more points, sharing new received rewards to others via the players' social media, or showing the summary of health benefits received from the game playing to other non-players. The game providers should promote these values to innovators and early adopters by having some marketing strategies to let them persuade others who are their friends, family, or peers. For instance, letting them make exclusive invitations to their friends or giving them special rewards e.g. Pokemon if they successfully invite their friends to join the game (to create early majority). For the group such as late majority or laggards, game providers should set some events that open to public (everyone) and also let existing players bring non-players (their family, friends, or acquaintances) to join. In these events, influencers should persuade potential users to try and give them more information e.g. the enjoyment and trialability of the game, and information about the game having no privacy invasion, simultaneously with conducting marketing promotions online through the game platform.

Conclusion, Limitation, And Future Research

The purpose of this study was to specify the antecedents of non-players' intention to play a mobile location-based AR game (Pokemon Go) in the future, mainly from the TAM constructs (perceived usefulness and perceived ease of use), a social factor (subjective norms), a promising factor in the game context (perceived enjoyment), and an obstacle (privacy concerns). The proposed research model was empirically tested based on 215 non-players of Pokemon Go in Thailand, who were in studying age or working age. Data were analyzed using descriptive statistics, confirmatory factor analysis, and structural equation modeling. The results pointed out that perceived enjoyment, perceived usefulness, and subjective norms directly positively affected intention to play Pokemon Go of non-adopters, whereas perceived ease of use could decrease their intention to play. Perceived enjoyment and subjective norms also indirectly influenced the intention to play. On the contrary, privacy concerns indirectly lowered non-adopters' intention to play in the future. Alzahrani et al. (2017), who studied online game playing among Malaysian undergraduate students, emphasized that future research should expand to different age groups rather than students and gameplaying mediums such as mobile devices. They also found insignificant effects of subjective norms on usage and suggested further analysis of social context. This study shows empirical evidence for an integrated model to understand determinants of non-adopters' intention to adopt a mobile location-based AR game and also complete past studies in terms of sampling both full-time students and full-time employees. Findings in this study compare and contrast results, showing the importance of subjective norms and the negative impact of perceived ease of use on the intention to play, which contributes knowledge in the location-based AR game literature.

There are some limitations, which should be considered in this study as follows. First, the samples were collected using non-probability sampling with students and employees in Thailand and the sample size was not large. Hence, the generalization of findings to other cultural environments may be limited. Future studies should collect more samples using quota sampling from other countries. Second, Vasseur and Kemp (2015) classified non-adopters as potential adopters and rejectors, but it was not categorized in this study. Thus, future research should gather data from various non-player groups, both potential adopters and rejectors, and compare and contrast between groups, to expand the research results. Third, perceived ease of use has a negative impact on the intention to play and has no impact on perceived usefulness. Although the insignificant effect is in line with some game studies, there is an avenue for future research using qualitative analysis to explore the reasons why it yields a negative impact or insignificant result. Fourth, this study focuses on intention to play the game in the future, future studies could deeply explore the levels of technology rejection and investigate barrier factors such as level of flexibility and risk factors such as (studying/ job) performance risk. In addition, future work should compare the benefit and risk factors influencing non-players and players, to enhance suggestions for location-based AR practitioners to develop different strategies and overcome obstacles for players and potential players. Future studies should add some control factors such as age and gender into the model to thoroughly understand the antecedents of users' intention to play. Last, this study focuses only on non-players of Pokemon Go, future research should replicate this study to other mobile location-based AR games such as Let's Hunt Monsters, Jurassic Park Alive, The Walking Dead Our World, Harry Potter Wizards Unite, and Ghostbusters World, which may have different design of game aesthetics, dynamics, and mechanics.

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Research on the Realization Path of Intelligent Logistics in the "New Retail" Era

(Full Paper)

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ABSTRACT

"New retail" is the product of innovation and transformation of e-commerce, physical retail and modern logistics. "New retail" relies on omni-channel logistics based on supply chain integration, order-driven precise logistics service and high intensity urban distribution carrying capacity, which has brought huge impacts and development opportunities to the logistics industry. At present, there are limitations in China's intelligent logistics, both in terms of logistics infrastructure construction, logistics information services, and regulatory guarantee systems, which restrict the development of "new retail". In order to realize the high-quality support of "new retail" by intelligent logistics, a trinity of intelligent logistics construction path of "government guidance, market leadership, and social co-governance" is proposed. We should accelerate the construction of intelligent logistics infrastructure under the guidance of the government, give full play to the leading role of the market to build an intelligent logistics information platform, and build a multi-security logistics security system through joint governance of all sectors of society to meet the overall objective of the high-quality support of logistics for "new retail".

Keywords: "New retail", intelligent logistics, logistics information

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INTRODUCTION

The theoretical basis of "new retail" is rooted in the relevant theories of modern marketing, which can be traced back to the early 1960s. Professor Jerome McCarthy put forward the 4Ps theory. Firstly, the marketing factors of enterprises are defined as products, prices, channels, promotions and strategies. In 1984, Professor Philip Kotler added two factors, political power and public relations based on 4Ps theory, forming a large marketing mix. Robert F. Lauterborn put forward the four factors marketing 4Cs theory of customer, cost, convenience and communication, which emphasized the goal of customer satisfaction and attached importance to communication and communication with customers in 1990. When 4Cs marketing theory was put forward, it coincided with the development of Internet companies all over the world. With the vigorous development of the Internet, e-commerce has subverted the dominant position of traditional store sales, supported by the logistics industry and related platforms, and accelerated the transformation of residents' income to consumption. However, in recent years, due to the consumption upgrading and the inherent disadvantages of e-commerce, such as short logistics board, product homogeneity, and poor experience, pure e-commerce is increasingly unable to meet consumer demand. In 2016, Ma Yun first proposed the concept of "new retail" and proposed that only "online and offline + modern logistics" can truly create a "new retail" form. "New retail" is a new kind of intelligent retail, which is the product of the era of e-commerce, physical retail and modern logistics innovation, transformation and formation of joint forces. It has a huge impact on the life of consumers, is closely related to the enterprise and its future development mode and is highly concerned by all sectors of society.

Although the industry has not yet formed a unified standardized expression for the "new retail" form, the proposal of this business form plays an important role in guiding the integration of online, offline and multi-platform, the innovation and development of e-commerce and physical stores, and the transformation and upgrading of the future logistics industry. The basic purpose of "new retail" is to make consumers more convenient and cheaper to buy better goods, which puts forward higher requirements for modern logistics system from the perspective of efficiency and cost. Innovation, transformation and upgrading of logistics business model is an important way to adapt to the "new retail" (Tang & Yang, 2018). The transformation and upgrading trend of the logistics industry is the intelligent logistics integrating the digital technologies such as big data, the Internet of Things, and cloud computing. The definition of intelligent logistics originates from the "intelligent supply chain" proposed by IBM in 2009, emphasizing the use of intelligent technology to improve the automation level of logistics systems. For the understanding of intelligent logistics, scholars have given different views from different perspectives. He (2017) believed that the new ecology based on the Internet of Things and big data, through collaborative sharing of innovation models and advanced artificial intelligence technology, reshapes the division of labor, restructures the industrial structure, and changes the mode of industrial development is defined as smart logistics. The new ecology of structure and transformation of industrial development is defined as intelligent logistics. Lin (2018) proposed that intelligent logistics is the cooperation between humans and machines through data to let the machine complete all the repetitive, non-funny, and machine-solvable things. Zhang (2019) pointed that intelligent logistics is to apply the new generation of information technology to the logistics industry and logistics management in order to play the role of integrating logistics resources, easing the labor shortage and promoting industrial upgrading. It cannot be simply understood as the application of unmanned

warehouse, unmanned vehicle and UAV. Intelligent logistics is the dialectic of dynamic concept and definite mode, which is not only a problem at the technical level, but also a concept of system integration (Wang, 2014). Intelligent logistics presents advanced features such as comprehensive perception, automated execution, intelligent decision-making, and deep collaboration (Zhang, 2019). It emphasizes the innovation of automation, visualization, controllability, intelligence and network of logistics with the fine, dynamic and scientific management mode (Wang, 2016). Foreign scholars have studied intelligent logistics from the perspective of intelligent city. Russo, Rindone, and Panccio (2016) took the urban intelligent logistics solution as a case study and verified the way to implement the European Intelligent City. As a new social infrastructure, intelligent logistics connects consumers and suppliers. Building an efficient intelligent logistics system is of great and far-reaching significance to promote the cost reduction and efficiency improvement of the logistics industry and better serve the national development strategy. At present, clarifying the important limitations in the development process of China's intelligent logistics, recognizing the new requirements of "new retail" on China's intelligent logistics, and constructing a scientific and reasonable implementation path of intelligent logistics, is conducive to promoting the high-quality development of "new retail"

LIMITATIONS OF INTELLIGENT LOGISTICS DEVELOPMENT IN THE "NEW RETAIL" ERA

At present, some enterprises in China have begun to practice intelligent logistics, and the government has also given policy support in the development of intelligent logistics. However, China's intelligent logistics is far behind developed countries such as Japan and the United States. There are a lot of outstanding problems to be solved in terms of intelligent logistics infrastructure, logistics information standards, information platform services, regulatory and security systems Problem. Yu (2019) pointed out that there are some problems in the development of intelligent logistics, such as slow formulation of industry standards, insufficient enterprise scale, backward infrastructure, imperfect information platform, low level of intelligent terminal logistics and lack of professional talents. In order to vigorously promote the development process of intelligent logistics in China and promote the transformation of modern logistics operation models, it is of great significance to correctly understand the obstacles facing the development of intelligent logistics in China (Wang & Lin, 2019).

Weak Intelligent Logistics Infrastructure

Compared with developed countries, China's intelligent logistics started late, and the level of intelligent logistics infrastructure and Internet infrastructure is seriously insufficient, which makes it difficult to achieve intelligent matching and operation between all aspects of logistics. The weakness of intelligent logistics infrastructure is mainly manifested in the imperfect layout of national logistics hub, relatively backward regional intelligent logistics distribution center and poor comprehensive service capacity of commercial logistics infrastructure. Although China has invested a lot in the digital transformation of traditional logistics and the construction of national intelligent logistics backbone network, which has contributed to the cost reduction and efficiency increase of the logistics industry, there are still many problems in the overall layout of public logistics infrastructure construction, such as the poor matching of top-level design and planning route, the dislocation of intelligent logistics investment and financing, and the urban-rural distribution system. However, the weakness restricts the development of many high-quality logistics parks in the direction of multi-functional integration, and affects the overall process of intelligent logistics development. Many regional logistics distribution centers are still limited to the storage and self-use stage, and have not completed the intelligent upgrading and transformation, unable to play the social service function. In some cities, especially some small and medium-sized cities, public storage and distribution centers have not been set up in shopping malls and commercial pedestrian streets, and the level of information sharing is still at a low level. The end of public express is constructed repeatedly, and the application scope of self-lifting equipment is small, which has not yet been promoted and opened in many communities and business circles. Due to the lack of efficient logistics information technology in China's logistics enterprises as a support, the lagging of data infrastructure directly leads to higher logistics costs, which seriously affects the quality of logistics services.

Backward Intelligent Logistics Information Platform and Information Standards

The logistics information platform for users to publish information and share services is an indispensable core competitiveness of logistics enterprises. In 2016, there was a lack of information interconnection between more than 70 million small and medium-sized enterprises and individual businesses across the country. The phenomenon of "Information Island" was prominent. The index value of logistics data infrastructure was only 18.8, which was still in the initial stage of development. Backward information technology, poor information exchange and weak integration of information resources have become important obstacles for logistics enterprises to optimize business process, build credit evaluation system and obtain formal financial resources. The application function of logistics information platform has not been given full play. At present, most enterprises' logistics information platform is mainly used for information release. Few enterprises can use the information platform to realize the application functions of logistics finance, logistics transaction, sharing supervision and supply chain management integrated service. In order to eliminate the barriers of information communication between different enterprises, it is necessary to realize the data exchange and information docking between the logistics enterprise platform and the production system and the circulation system platform, as well as the integration and interaction between the systems (Mao, 2018), and to standardize the relevant codes. At present, there is a general lack of basic standards for logistics information in China. The information system interfaces between logistics enterprise platforms and customer production, transportation systems and other platforms are not consistent. The formulation and modification of relevant business standards and technical standards are also difficult to meet the needs of logistics development. On the one hand, customers are unable to achieve mass business data entry according to standards, on the other hand, many personalized interfaces reduce logistics Operation

efficiency of the enterprise. It is worth noting that the logistics information platform and information system are independent, and the logistics network is not compatible with each other, which will not only make the information exchange, information sharing and business collaboration between enterprise systems in the industrial chain difficult to achieve, but also increase the time and cost of goods from manufacturers to consumers.

Imperfect social Supervision and Security System of Intelligent Logistics

Intelligent logistics is a local market involving multiple departments. The behavior coordination among the participants is different from the direct control of the upper and lower levels within the enterprise, and more emphasis is placed on the cooperation between the networked virtual organizations. The network operation mode of breaking the enterprise boundary and ownership restriction makes the relevant regulatory system, especially the tax system, unable to adapt, which is easy to breed part of the intelligent logistics business model wandering in the gray area (He, 2017). The division of logistics management departments and operating enterprises is a phenomenon that separates the logistics management authority that originally belonged to the same system resources to different departments, restricting the formation of a social logistics distribution system. On the one hand, chaotic multi-part supervision methods are likely to cause regulatory gaps or excessive supervision. In order to cope with the supervision of different administrative departments, enterprises will consume a lot of financial, material and human resources and increase the operating burden of the enterprise. On the other hand, poor service attitudes, unclear complaints agencies, customers unable to dynamically grasp logistics information, difficulties in complaints, etc. will also trouble consumers. Intelligent logistics uses Internet technology to build an industrial ecosystem. The traditional familiar cooperation mode in the past will be broken. The scope of participants in the system will be greatly expanded than in the past. It will maintain many strange relationships and form normal market transactions. It is necessary to pay more attention to the construction of laws and regulations and social integrity system. In addition, most small and medium-sized logistics enterprises are struggling in the construction of intelligent logistics due to the lack of joint support of high-end elements such as scientific and technological innovation, financial resources and human capital. Despite the introduction of intelligent logistics technology, there is no corresponding capital guarantee and the lack of intelligent logistics professionals, which greatly hinders the development of intelligent logistics.

REQUIREMENTS OF "NEW RETAIL" ON DEVELOPMENT OF INTELLIGENT LOGISTICS

As a key element of "new retail", logistics has attracted wide attention of the academic community. Many scholars believe that "new retail" is the subversion and reconstruction of the original retail format and puts forward new requirements for the logistics industry (Ren, 2018). Logistics is indispensable in "new retail" and it also is the support and guarantee of "new retail" (Ma, 2018; Zhang, 2018). Logistics is an important service factor for the competitiveness of the new retail enterprises (Wei & Di, 2018). Under "new retail" mode, the future logistics market will move towards omni-channel logistics, and express companies will focus more on the direction of urban logistics distribution (Shen, 2017). Terminal real-time logistics has become an important part of the development of new logistics (Ma, 2018). "New retail" will fully affect the development model of the logistics industry. Online and offline integration, and service product integration are an inevitable trend. In order to improve the level of management of goods and services in physical stores, better satisfy the consumer experience, and improve the efficiency of business flow configuration, offline entities and channels must develop digitally. At the same time, offline store products will also interact with online data to achieve seamless integration between traditional retail digitalization and online e-commerce offline. Therefore, driven by "new retail", manufacturers' goods will shift from pure e-commerce configuration to offline digital configuration. "New retail" is a new business form to open up "online network ecological economy + offline real community economy". However, the quality and effect of all channel circulation, which is deeply integrated online and offline, depends on the efficient support of logistics links. Therefore, we will consider the limitations of China's intelligent logistics development in the era of "new retail" and analyze the requirements of "new retail" for the development of intelligent logistics on the basis of previous research in this section.

Integration of Omni-channel Logistics Relying on the Supply Chain

Driven by the "Internet +" strategy and the upgrading of consumer spending, major brands are trying to overcome the consumption defects and defects caused by the early pure electronic business operation and try to innovate the "new retail" business form. It is the core demand of "new retail" to meet the user's individual needs and improve the user experience, and the user experience effect is closely related to the logistics service quality. Traditional logistics includes several links, such as shippers, logistics enterprises, transportation companies, end customers, etc. low circulation efficiency and high time cost are the obstacles to the development of "new retail". In recent years, the product supply trend of manufacturers has gradually changed from relying on the distribution of channel providers in the past to the operation mode of direct delivery from production base to cloud warehouse in various regions. In this mode, it is necessary to analyze the sales volume of various regions through big data of the Internet and formulate a complete supply chain plan in advance. Therefore, in the "new retail" era, logistics links not only need to be closely linked with business modules such as enterprise strategy, marketing, demand forecasting, commodity development, but also need to establish cooperation relationship with supply chain partners according to each link of commodity supply, rely on supply chain integration to build Omni channel logistics, and concentrate on each link of Omni channel logistics with partners, so as to adapt to the new situation The requirement of retail reform.

"New retail" requires intelligent logistics to build a highly flexible development management system and requires higher service quality in the supply chain logistics system. With the maturity of new digital technologies such as big data, the Internet of Things and artificial intelligence, and the increasing application of intelligent devices and sensing devices, the nodes in the

intelligent logistics system of the supply chain will be aware of the information in "new retail" sector. It will be more sensitive, and internal companies in the supply chain can change production strategies and development strategies quickly and at any time according to external incentives, and more adapt to the needs of "new retail" market development.

Order-driven Precise Logistics Service

Under the development model of "new retail", intelligent logistics must be upgraded from supply-driven to demand-driven. At present, the asymmetry of information in the logistics system leads to the delay of information transmission in the logistics system, and upstream and downstream companies in the supply chain cannot respond quickly to market demand, resulting in high logistics costs. With the application of the new generation of digital technology, once information can be circulated at high speed between nodes in the supply chain, each enterprise can quickly grasp the market demand and take differentiated measures according to the different needs of consumers. Quick response can be achieved by intelligent logistics services. "New retail" emphasizes the high integration of online and offline and logistics, in which logistics is the media to realize the organic connection between online and offline and an important link for "new retail" to achieve the goal of zero inventory. Therefore, under the "new retail" background, the focus of intelligent logistics is not only to improve speed and efficiency, but also to help operators reduce inventory backlog.

In addition, the core of "new retail" is accurate recording, analysis and prediction of consumer behavior, as well as accurate supply chain logistics services based on customer personalized demand. This requires that logistics can accurately predict sales volume, allocate inventory according to effective orders, accelerate circulation, quickly respond to goods sent to consumers, improve user experience, and reduce inventory costs of businesses. Therefore, the logistics industry needs to reform, innovate, transform and upgrade according to the requirements of the "new retail" business form, and provide timely and accurate logistics services according to the generation of effective orders from users. Specifically, according to the order quantity, it is directly sent from the factory or the place of origin to the logistics of the user's destination area, removing the unnecessary links in the middle, completing the whole operation process with the fastest speed and the least cost, realizing the seamless connection between retail and logistics process, and providing accurate logistics services for businesses and consumers.

High-strength Urban Distribution Carrying Capacity

According to the report of the China Institute of Intelligent Logistics, the average daily express delivery volume of express service companies across the country has exceeded 100 million pieces since May 2017, marking that China has entered the "100 million pieces era" of single-day delivery. With the accelerated development of e-commerce and "new retail", the number of delivery orders for express delivery services will continue to increase. Consumers' individual needs for delivery speed and service quality will place stringent requirements on urban delivery capabilities. After the goods arrive at the distribution center through the logistics trunk line, they are delivered to the target customers through the city distribution enterprises or express companies. Urban distribution business mainly includes distribution center to stores and distribution center to end consumers. With the development of "new retail" business form, the business volume from distribution center to community stores, Business District stores and specialty stores will increase rapidly than in the past, which needs to match the high-strength urban distribution carrying capacity.

At present, the existing urban distribution enterprises and express companies mainly focus on the logistics distribution business from the distribution center to the end consumers, but still need to improve the distribution efficiency. Accordingly, many city distribution enterprises and express companies are less involved in the business from distribution center to stores. With the rapid development of the Internet economy and the continuous acceleration of urbanization, the status of end logistics, which is often referred to as the "last mile" problem, has become increasingly prominent. In January 2018, the General Office of the State Council issued the "Opinions on Promoting the Coordinated Development of E-commerce and Express Logistics", stating that "reinforcement of service innovation and enhancement of end-logistics service capabilities". Express delivery and e-commerce, etc. face the "last mile" of logistics, and in semi-open spaces such as more vertical communities, campuses, and industrial parks, there is also a large demand for express delivery. However, under the background of "new retail" business, the business from the distribution center to the store will be an important market in the field of urban distribution logistics in the future, which requires the existing urban distribution or express companies to seize the opportunity, actively respond, and "implant" Internet technologies such as big data and Internet of Things into the logistics storage system, and improve the logistics response speed and service level through intelligence. In May 2015, the State Council issued a notice on the issuance of "Made in China 2025", which states that it is necessary to coordinate the layout and promote the research and development and industry of intelligent vehicles, intelligent construction machinery, service robots, intelligent appliances, intelligent lighting appliances, wearable devices and other products. Therefore, in order to alleviate the shortcomings of distribution services, intelligent logistics robots will become an important supplement for terminal distribution in the future.

REALIZATION PATH OF INTELLIGENT LOGISTICS IN THE "NEW RETAIL" ERA

In the "new retail" era, intelligent logistics is a mid-leap upgrade of the traditional logistics model, an advanced stage of the development of the logistics industry, and an important extension of the development of integrated logistics. Intelligent logistics should be supported by digital technology, with modern logistics management systems as the core, and achieve high integration of production, processing, sales, and distribution in accordance with "new retail" requirements. In the process of connecting with various subsystems, we must attach importance to the intelligent role of "smart" systems, connect supply chain enterprises in the form of automation and intelligence, and realize the internal resource sharing and information exchange of

the supply chain ecosystem. The development of logistics enterprises is limited, the logistics information standard, information platform, supervision and security system are backward, and the lack of logistics professionals restricts the development of "new retail". The traditional logistics configuration mode obviously cannot bear the demands of "new retail". Therefore, considering the current constraints in the development of logistics, combined with the new requirements of the "new retail" business form for logistics efficiency and service quality, a three in one intelligent logistics realization path of "government guided accelerating the construction of intelligent logistics infrastructure, market led construction of intelligent logistics information platform, and social co governance construction of intelligent logistics security system" is constructed to finally meet the new demands of logistics. The overall goal of retail high-quality support is shown in Figure 1.

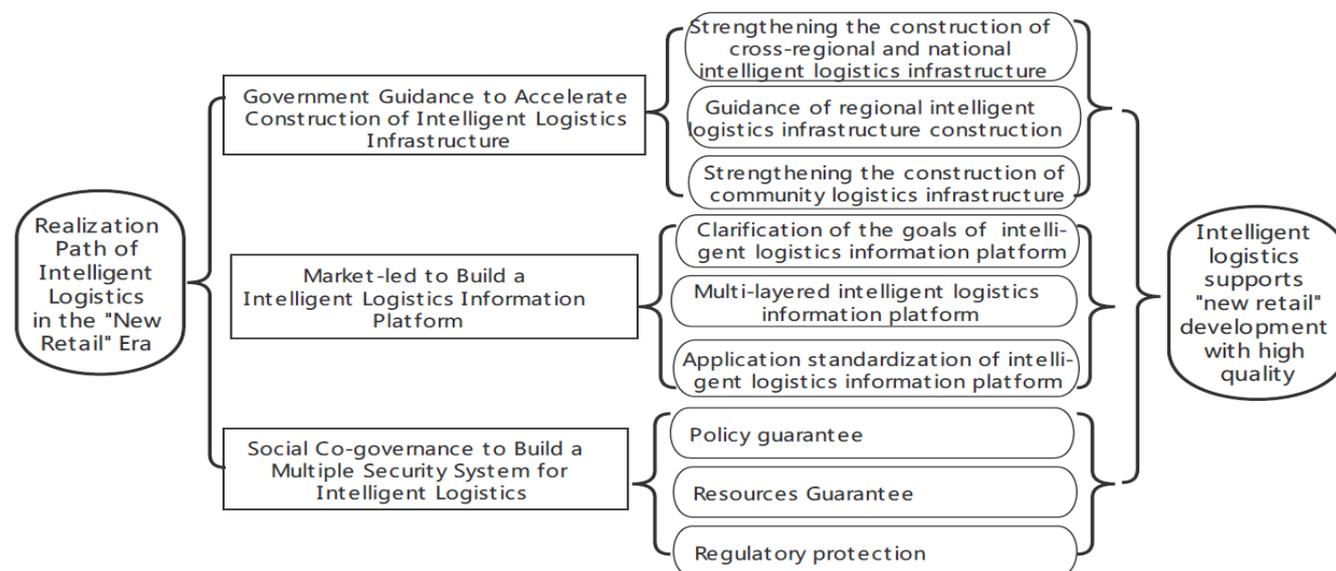


Figure 1: Framework of intelligent logistics implementation path in the era of "new retail".

Government Guidance to Accelerate Construction of Intelligent Logistics Infrastructure

In 2016, the general office of the State Council clearly pointed out the importance of "Internet +" efficient logistics to the economic development of the whole society in the "Internet plus" efficient logistics implementation opinion. In 2017, the integration and innovation of AI and logistics industry was emphasized in the new generation AI development plan. Under the background of "new retail", intelligent logistics has become the trend of structural reform and innovation and upgrading in China's logistics industry. The construction of intelligent logistics system needs to find the entry point to serve the local economy, and the government promotes and supports a number of major forces in the transformation and upgrading of the logistics field (Yu & Wang, 2015). Although in recent years, China's logistics infrastructure has achieved a leap forward development, and the logistics infrastructure network has been basically formed, there is still a big gap between China's logistics development and the requirements of "new retail" economic development mode. It is necessary to speed up the construction of intelligent logistics infrastructure from multiple levels, such as the layout of cross regional logistics hub, regional logistics distribution and commercial logistics warehousing distribution.

Strengthening the construction of cross-regional and national intelligent logistics infrastructure

To achieve high-quality logistics support for "new retail", relevant departments must formulate and implement intelligent logistics development strategies, formulate special plans for intelligent logistics, compile a road map for intelligent logistics technology and equipment, and carry out major intelligent technology and equipment technology breakthroughs. From the logistics industry strategic planning, resource allocation and other macro level guidance, speed up the construction of the national intelligent logistics backbone network, synchronously improve the level of logistics modernization software and hardware. He (2019) scientifically planned and implemented the layout of national logistics hubs and strengthened the supporting construction of various hub facilities in inland regions of the central and western regions, large and medium-sized consumer cities, and key manufacturing industrial clusters. At the same time, according to the national consumption upgrade strategy, focus on promoting the development of consumer logistics; in accordance with the strategy of revitalizing the countryside, build an agricultural and rural logistics service system; and rely on the "Belt and Road" to increase investment in the construction of international transport trunk routes, and use cross-border e-commerce to promote international express Development, speed up the layout of overseas warehousing, and use cross-border logistics networks to drive domestic enterprises to expand overseas.

Guidance of regional intelligent logistics infrastructure construction

Support and cultivate a number of advanced intelligent logistics leading enterprises, creatively use the investment promotion means of logistics industry chain to build intelligent logistics industry cluster and promote the upgrading and transformation of intelligent logistics park, promote the integration of local highway port into Logistics Park. We must attach importance to strengthening the construction of digital logistics infrastructure, build a logistics Internet, guide the development of online and

offline integration of infrastructure, and pay attention to releasing the convergence effect of the park to a greater extent. At the same time, we should encourage the logistics distribution centers around the city to carry out the storage automation transformation, improve the efficiency of urban logistics operation, improve the coverage and accuracy of the logistics Internet, and promote the transformation and upgrading of the logistics park to the supply chain logistics integrator, so as to meet the development requirements of "new retail" relying on the supply chain to build the omni-channel logistics.

Strengthening the construction of commercial logistics infrastructure

Facing the market opportunities brought by intelligence, the government should strengthen policy support, encourage enterprises to realize the intelligence of logistics equipment from various fields such as storage equipment, transportation equipment and operating system, and at the same time, promote enterprises to use the new generation technologies such as mobile Internet and big data to accelerate the innovation and development of intelligent logistics terminal products, and encourage community business circles to lay out public warehousing distribution centers To improve the level of information sharing, reduce the waste of repeated construction resources, take the intelligent express of modern high-end industries such as national intelligent logistics backbone network, comprehensively improve efficiency and reduce cost, and truly realize the deep integration of modern logistics, online service and offline experience. At the same time, we should encourage the construction of backbone logistics information platforms, promote the comprehensive connection of logistics elements, and implement digital and intelligent transformation projects for small and medium-sized logistics enterprises.

Market-led to Build an Intelligent Logistics Information Platform

In order to adapt to the needs of "new retail" market for customer personalized service, the operation basis of logistics service depends on the level of information technology. Only when the logistics information is open, transparent and fully shared, can the seamless connection between retail and logistics be truly realized. According to the needs of "new retail" market, the construction of intelligent logistics information platform needs to consider the design of platform objectives, business architecture and application standards.

Clarification of the goals of the intelligent logistics information platform

In July 2016, the National Development and Reform Commission issued the "Internet +" Efficient Logistics Implementation Opinions, which proposed "to form an intelligent logistics ecosystem based on the Internet, open sharing, win-win cooperation, efficient and convenient, green and safe, and the efficiency of logistics efficiency has greatly improved". From the perspective of the goal design of intelligent logistics information platform, we should use new IT technologies such as big data, cloud computing, artificial intelligence, etc. to open up information connectivity channels, establish an open and shared logistics information platform, and provide all kinds of enterprises in the supply chain with omni-channel Logistics problem-solving solutions, so as to achieve service integration, process visualization, electronic transactions and operation standardization and customer service personalized design goal, to meet "new retail" demand for intelligent logistics precision service and efficient operation.

Multi-layered intelligent logistics information platform

From the perspective of business architecture of intelligent logistics information platform, we should focus on business construction from multiple levels of industrial management and control, supply chain management and enterprise operation according to market demand, and reasonably and scientifically organize according to the business characteristics of each level. Industrial management and control is based on the design of goods category, flow direction and supply demand from the perspective of brand goods circulation; supply chain management is mainly designed from three aspects of supply, production and marketing; business layer focuses on the design of enterprise warehousing, distribution, transportation and other basic logistics business and process control, decision optimization, information release and other aspects. In addition, the business structure of intelligent logistics can also be expanded from horizontal, vertical, and spatial dimensions according to the type of internal node enterprises to achieve development, transformation and upgrading. Vertically, we can provide customization and R & D services. Horizontally, it can provide services such as supply chain finance, credit evaluation, and risk assessment. In space, global supply chain logistics and global value chain logistics can be built.

Application standardization of intelligent logistics information platform

The formulation of intelligent logistics industry standards is conducive to achieving technological and business connections, promoting the direct connection of intelligent logistics systems to the outside world, and smoothly adding external information into the supply chain system. From the standpoint of the application of intelligent logistics information platform, the future logistics industry, manufacturing industry, e-commerce, AI should be highly integrated into the "Internet +". According to the market supply and demand mechanism, price mechanism and incentive mechanism, we should formulate the logistics information collection standards such as barcode, RFID technology, and standardize the docking and information exchange between different links of information systems. In terms of technology, the application standards in all links of logistics business shall be unified, the construction of intelligent logistics standardization system shall be accelerated, and the construction of intelligent logistics information sharing platform shall be promoted At the same time, communication channels are built between users and platform business design through communication devices such as computers, mobile phones, telephones, etc., and intelligent logistics information technology is applied to complete information capture, information preprocessing, data storage and exchange, data analysis and mining, and data prediction, so as to finally realize the intelligent control of brand goods circulation, supply chain management and enterprise management.

Social Co-governance to Build a Multiple Security System for Intelligent Logistics

The infrastructure construction and information sharing platform construction of intelligent logistics are inseparable from the support of modern finance, scientific and technological innovation, human resources and other high-end production factors, and need the extensive support of all sectors of society and all parties. Intelligent logistics has become an important hand in the supply side structural reform of China's logistics industry (He, 2017). Governments at all levels, financial departments, relevant enterprises, social and public services and other relevant institutions should work together to co govern, and provide guarantee for the better development of intelligent logistics from policy, resources, supervision and other aspects.

Policy guarantee

The impact of technology on the logistics industry from all aspects of warehousing, transportation and distribution has become a key tool for reducing costs and increasing efficiency in the logistics industry. In recent years, the Chinese government has issued a number of policies to promote logistics cost reduction and efficiency, vigorously promote the innovation of the logistics industry, and will have a profound impact on the development of intelligent logistics. The government should do a good job in the overall layout of the development of intelligent logistics from the strategic level, draw up the overall planning and route design of the development of intelligent logistics, coordinate the work of all functional departments, and comprehensively formulate the relevant management systems and guidelines conducive to the formation of a good incentive mechanism, coordination mechanism and supervision mechanism, so as to create a good policy environment for the development of intelligent logistics. We need to study and formulate new supporting policies in response to emerging situations and problems, carry out digital governance of the platform, and innovate government supervision platforms and platform management companies' supervision methods (He, 2019).

Resources Guarantee

The government should introduce fiscal and taxation guidance policies, provide financial support for the development of the intelligent logistics real economy through a multi-pronged approach such as fiscal investment, financial support, and tax incentives, and solve digital governance issues and policy obstacles in new technologies, new models, and new formats. We need to encourage social capital to set up industrial investment funds and promote innovation in intelligent logistics models. We should set up intelligent logistics development and innovation guidance fund, encourage enterprises to innovate and develop intelligent logistics facilities, equipment and information system, promote the construction of intelligent logistics innovation projects and intelligent logistics entrepreneurial park; colleges and universities should actively cooperate with the government, enterprises and logistics associations Training institutions work together to develop intelligent logistics talents training programs suitable for the development of China's current logistics industry in combination with the requirements of the development of "new retail" business forms, so as to make the relevant education and industry demand well connected in talent construction (Fu, 2018), and learn from the advanced successful experience of foreign countries, accelerate the cultivation and introduction of high-end intelligent logistics talents, and improve China's intelligent logistics talents Market mechanism of services.

Regulatory protection

The "13th Five-Year Plan" for the development of express delivery industry requires that the application of modern information technologies such as mobile Internet, Internet of Things, big data, cloud computing, virtual reality, artificial intelligence, etc. in enterprise management, market services, and industry supervision be strengthened. Therefore, we need to carry out digital governance of the platform and innovate the supervision method of the government supervision platform and platform management enterprises. In view of the shortcomings of the current development of intelligent logistics which is neglected in supervision, it is necessary to formulate relevant supervision laws as soon as possible, clarify the contents and methods of supervision, build a socialized credit system, prevent and resolve risks, and maintain the market environment of fair competition of intelligent logistics. A professional logistics supervision department should be established to strengthen service supervision in the logistics industry, and relevant functional departments should formulate unified standards to increase investigation and punishment of line violations in the logistics industry. At the same time, we must give full play to the role of industry associations in serving logistics companies and industries, build an indicator system, policy system, standard system, statistical system, performance evaluation system that meets the requirements for high-quality logistics development, and improve the industry supervision system and Governance mechanism.

CONCLUSIONS

The application of intelligent logistics in different scenarios makes it more flexible and more responsive than traditional mature logistics systems in terms of efficiency, cost and user experience. Intelligent logistics has become the guiding force for industrial development, and it is the only way for the development of China's logistics industry. "New retail" is the product of the era when e-commerce, physical retail and modern logistics innovation and transformation are integrated. The development of "new retail" and intelligent logistics integrates business flow, logistics, information flow, and capital flow into a new supply chain. The "retail + supply chain ecosystem" model is the road to future development. "New retail" relies on omni-channel logistics based on supply chain integration, order-driven precision logistics services, and high-strength urban distribution carrying capacity, which has brought huge impacts and development opportunities to the logistics industry. At present, China's intelligent logistics has limitations both in terms of logistics infrastructure construction, logistics information services, and regulatory guarantee systems, which restricts the development process of "new retail". In order to realize the high-quality

support of "new retail" by intelligent logistics, a trinity of intelligent logistics construction path of "government guidance, market leadership, and social co-governance" is proposed. Under the guidance of the government, accelerate the construction of intelligent logistics infrastructure, give full play to the leading role of the market, build an intelligent logistics information platform, and build a multi-system of intelligent logistics through joint governance from all sectors of society to meet the high-quality support of logistics for "new retail".

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Research and Prediction on the Sharing of WeChat Official Accounts' Articles (Full Paper)

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ABSTRACT

With the development of mobile Internet, We Media was born. WeChat Official Account Platform is the largest we media platform in China. In WeChat social network, information can only be rapidly spread through the sharing operation of users. This paper takes WeChat official accounts as the object and uses logistic regression model to explore the influencing factors on sharing. After that, a prediction model is constructed based on logistic regression and support vector machine. The significance of this study is to propose the factors that influence WeChat official accounts' articles sharing, and to construct a sharing prediction model.

Keywords: WeChat Official Account, Sharing Behavior, Sharing Prediction.

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INTRODUCTION

WeChat launched by Tencent in January 2011 is an instant messenger software based on mobile Internet. According to the 2018 WeChat Data Report, the number of active users reached 1.082 billion in 2018.

As an important component of WeChat system, WeChat official accounts have attracted more than 80% of users to subscribe. In the WeChat system, the relationship between users and official accounts is "follow and followed", in which the official accounts are information publishers and the users are information recipients. Following an official account, one can receive the messages from it and make some interactive actions, such as praise, comment, sharing and collection.

WeChat provides an appropriate place for dissemination of high-quality content. According to the WeChat Official Account Population Insight Report, more than half of WeChat users have shared articles published in Subscriptions. Actually, the subscribers of WeChat official accounts are impressionable. Most people will pay attention to a WeChat official account if it is recommended by others. Based on the "point-to-point" mode of transmission, the WeChat official account is relatively closed and private compared with forums, micro-blog and so on. Every WeChat official account can deliver its content to those who subscribed, which means disadvantages in mass dissemination and secondary spread. In WeChat social media network, information dissemination depends on users' sharing. Therefore, users' sharing behavior is critical to the transfer of information.

The relationship among WeChat users, WeChat official accounts and information is shown in the Figure 1.

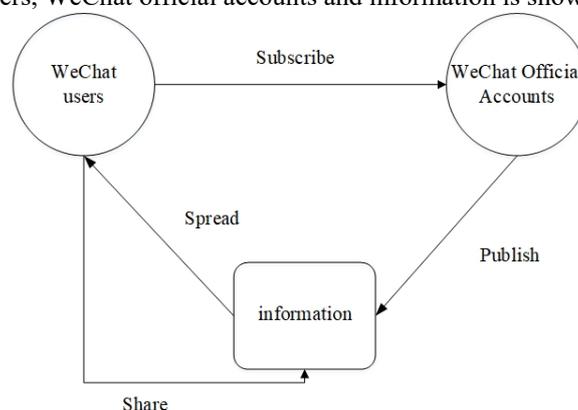


Figure 1: Relationship between WeChat users, official accounts and information

Due to the characteristics of this platform of WeChat, the official accounts can only deliver information to the users who follow them. Information dissemination can be chopper style through users' sharing. Therefore, users' sharing behavior is particularly important for the transmission of WeChat content. The mechanism of sharing can be deeply understood by this research on influencing factors, which can help account operations to grasp users' mind and real needs. Besides, the sharing

prediction model constructed in this article can accurately predict information dissemination rate and dissemination range, which has important practical guiding significance for study on WeChat users' behavior and interest, marketing, network public sentiment monitoring, and forecasting hot spots.

LITERATURE REVIEW

In recent years, many scholars have studied the sharing and reposting behavior of social media platforms such as Sina Weibo and Twitter from different technical perspectives and characteristics. Many excellent research achievements have come out. However, researches on the sharing behavior of WeChat official account are relatively less and lightly shallow.

Researches on WeChat official account

At present, the researches on WeChat official account mainly focus on the development status, user behavior, information dissemination. In terms of development status, many official accounts are studied as specific cases. Researchers summarize development characteristics, operation strategies and put forward problems and solving measures. In the research of user behavior, questionnaire survey is mostly used. Researchers pay attention to users' motivation, satisfaction, loss and willingness to continue subscribing. Many studies have introduced the "Uses and Gratifications" (Huang & Peng, 2014). Guan (2015) concluded that cognitive motivation and habitual motivation are the main motivation for users to use the official accounts and that information needs, social needs and entertainment needs are important factors in promoting users' willingness to use it. In the field of information dissemination, it is widely believed that the dissemination of WeChat official accounts has the characteristics of privacy, precision, deep reading and weak control (Jing & Zhou & Ma, 2014). It is not dominant in mass and rapid communication. Most of the researches focuses on the characteristics, process and mechanism of communication.

Research on the influencing factors of sharing

In recent years, users' sharing behavior in social media, such as Sina Weibo and Twitter, has attracted many scholars in the world. Current researches about WeChat official accounts concentrate on users' sharing motivation, the characteristics of information publisher and recipient and the characteristics of content. These research results have important reference significance for feature extraction of sharing behavior in this paper.

Apart from the above factors, some researches also include the characteristics of title, whether the official account is authenticated or not, and the frequency of delivery, based on the special mode of WeChat official accounts. Zhang and Li (2016) found that subject, article title, information source, presentation form and article length all affect the frequency of users' WeChat sharing. Wang (2015) put forward that whether the title could catch the user's eyes and hit the user directly has a decisive effect on the sharing rate of articles published in WeChat official accounts.

Research on the prediction of users' sharing

The researches on prediction of users' sharing behavior originated as Twitter became increasingly popular. Early studies focused on theoretical analysis about the causes, modes and contents of users' sharing behavior. Then, researchers use some machine learning algorithms such as logistic regression, support vector machine and neural network to construct the model, and predict the users' sharing behavior as a classification problem.

In order to improve the accuracy of the prediction on whether a user shares an article, researchers have explored more types of algorithms in recent years. Zhang, Lu and Yang (2012) proposed a method for predicting the reposting behavior of Weibo, with an overall hit rate of 85.9%. Wang, Feng, Jia, Zhu and Qin (2017) introduced neural network prediction algorithm in machine learning to build multi-feature prediction model. Zhou, Huang and Deng (2017) put forward a method by fusing anomaly detection with random forests. Others integrate the results of multiple machine learning algorithms according to some certain rules to obtain better prediction results than single learner (Zhang & Wang & Qin, 2018).

Apart from prediction on users' sharing behavior, some scholars study sharing volume prediction. Li, Yu and Liu (2013) proposed a prediction model based on SVM algorithm, but the complexity of feature computation is not suitable for large scale data. Deng, Ma, Liu, Zhang (2015) applied BP neural network to predict user sharing volume in emergencies, but whether it can be widely used has not been discussed. Some scholars also proposed a model based on sharing intention and sharing influence by analyzing the simulated sharing process (Zhao & Liu & Shi & Wu, 2016).

RESEARCH METHODS

Based on the existing literature and theoretical research, there are many factors affecting information sharing. Most of the researches on Sina Weibo's sharing were studied from several dimensions, which include information publishers, recipients and content's characteristics. These dimensions are detailed as follows: influence power of an account, whether an account is authenticated, the number of fans, age of the accounts, credibility of the Weibo content, length of the microblog, whether it contains a URL, whether it contains Image, whether it contains video, frequency of publication, delivery time, delivery date, and so on. Considering the similarity of information dissemination between Weibo and WeChat Official Account Platform, this paper divide the influencing factors on WeChat official account users' sharing into three categories: information publishers (WeChat official accounts), recipients (users), and information as well. Meanwhile, we integrate WeChat official accounts' own characteristics in the three aspects. The influencing factors model that affects the users of WeChat official accounts sharing, is as shown in Figure 2.

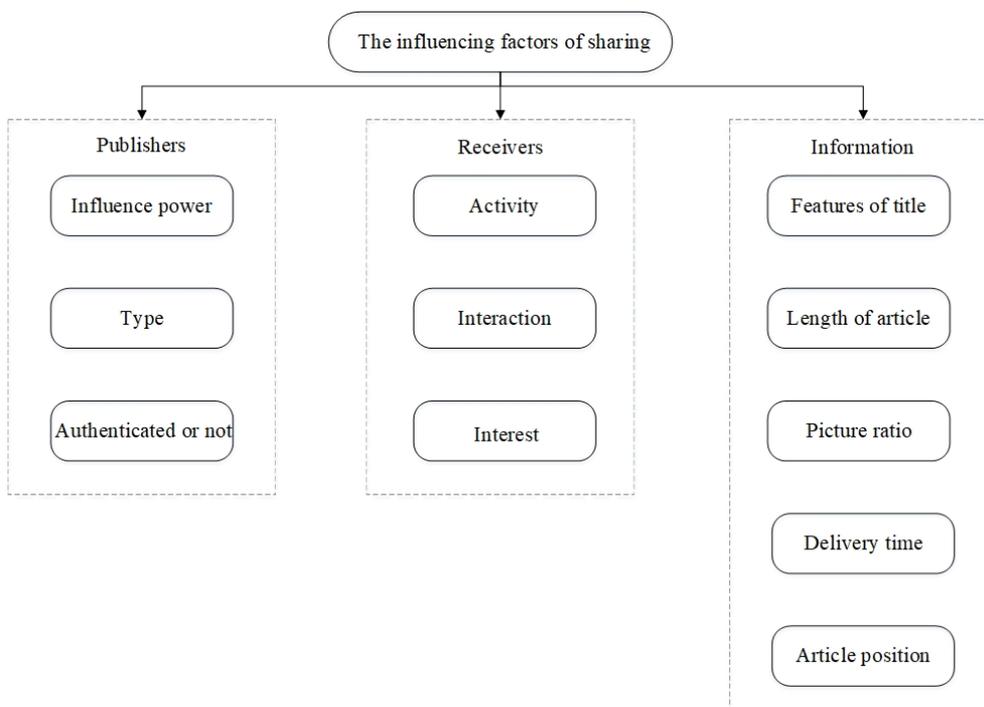


Figure 2: Three categories of the influence factors of sharing

Relevant technical methods

In this paper, the basic methods of logistic regression and support vector machine are used to quantitatively study the influencing factors of WeChat users’ sharing. Logistic regression model is used in studying the relationship between independent variables (official accounts’ characteristics, users’ characteristics and characteristics of information) and dependent variables (sharing) because the dependent variables selected in this paper are categorized variables, and independent variables have both continuous variables and categorized variables. In the process of predictive sharing, this paper classifies the research problem into a typical binary classification problem. Support vector machine algorithm is selected to construct sharing prediction model.

Relevant data analysis methods

In the process of data analysis in this paper, most of the work is on data preparation because the adequacy of data processing greatly affects the effect of the model. The data analysis in this paper involves data cleaning, correlation analysis, regression analysis, model training and model checking. The whole data analysis method is shown in the Figure 3.

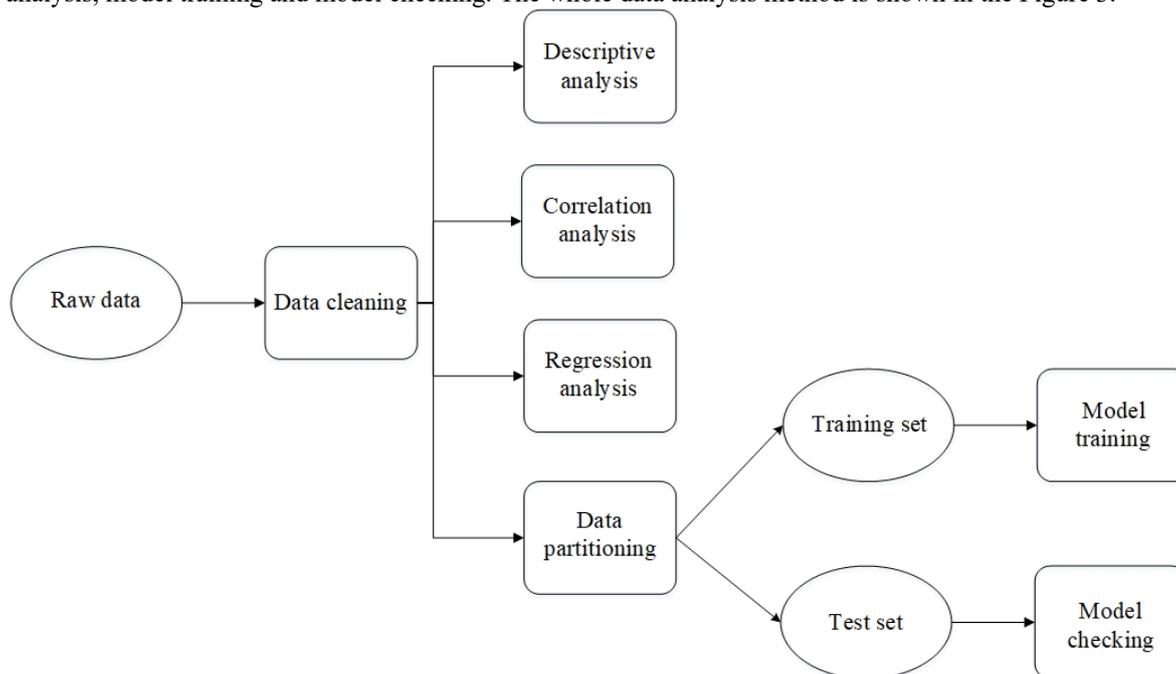


Figure 3: Data analysis method

DATA COLLECTION AND DESCRIPTION

Data Collection

With the help of Beijing Sootoo Internet Technology Company Limited who operates more than 100 WeChat official accounts, this paper selected 21 WeChat official accounts, the number of whose fans ranges from 100 thousand to 1 million and whose types include entertainment, emotion, adoration, fashion, health, finance, etc. These platforms' real operation data have been collected, including the identity number of accounts, the number of fans, article titles, article content, delivery time, article position, reading amount, sharing amount and other basic information. Partial data structure is shown in Table 1. This paper collected data from July 1, 2018 to December 31, 2018. During this period, the 21 official accounts published 13,000 articles, with a total reading quantity of 114 million and a total sharing quantity of 3.07 million. The number of fans, reading quantity, sharing quantity of the 21 official accounts are shown in Table 2.

Table 1: Partial data structure of published articles

Account ID	Delivery time	Title	Fans amount	Reading amount	Liking amount	...
gh_f0692ac72534	2018/07/01 17:16	The cat keeper is not a good keeper who doesn't allow cats enter air-conditioned rooms.	535,652	41,502	759	...
gh_f0692ac72534	2018/07/01 17:16	Speak out. What else is it that you cats take as a bed?	432,613	13,936	565	...
gh_87e04a3d2aea	2018/07/01 18:09	It is my greatest freedom to choose not to marry.	1,236,047	34,133	353	...

Table 2: Basic information Statistics of 21 WeChat official accounts

Account name	Follower amount	Article amount	Reading amount	Sharing amount
Movie Heaven	1,266,259	550	20,285	187
Creative Agency	1,235,968	829	19,008	448
Sales Tactics	1,113,732	656	10,167	504
Human Resources Management	1,095,755	853	9,202	459
Immortal Guo	1,074,336	807	11,338	133
Mood Signature	1,010,434	823	14,316	263
Encyclopedia of Health Fashion	652,339	617	10,621	683
Daily Yoga	604,659	929	8,209	175
Cat is coming	551,101	900	16,082	274
Short Novel	485,049	392	7,989	162
New Ideas	406,711	743	5,351	266
Constellations and Love Situation	402,065	606	7,821	69
Business personnel	384,785	652	2,851	126
Sales & Market	321,449	430	1,204	49
Selected Moments	317,430	754	1,857	76
An English Song Every Day	278,463	731	4,308	212
Financial Reference	230,886	275	3,860	67
Loving Fashion	229,717	328	3,521	35
Head News	204,020	600	1,451	69
Beautiful Trip	160,231	358	1,566	60
Music Valley	147,939	365	2,113	46

Data preprocessing

Data cleaning

The first step of data preprocessing is to clean up the original data, including data verification, outlier processing, identification processing of invalid samples and missing value processing. Data preprocessing provides high-quality and convincing data for subsequent data analysis and is the basis of all data activities. Because of the long time, some articles have been deleted by operators after being published, which may lead to large deviations in reading, sharing and other data. Meanwhile, some missing data were found by data checking. After preprocess, the effective data, 10,857 WeChat articles, were finally obtained.

Table 3: Statistics of data set

The number of accounts	The number of followers	The number of published articles	The number of sharing
21	12,173,328	10,857	2,543,396

Descriptive analysis

In the dimension of official account, the data obtained are analyzed and the information table of official accounts is formed. The table contains information collected by 21 official accounts from July 1, 2018 to December 31, 2018. According to the theme of the account, it can be divided into four categories: entertainment, emotion, life and sports and work information. Relevant descriptions are shown as follows.

Table 4: Four categories of collected official accounts

Category	Account name	The number of accounts	Average number of followers
Entertainment	Movie Heaven	5	716,634
	Creative Agency		
	Short Novel		
	Selected Moments		
	An English Song Every Day		
Emotion	Immortal Guo	5	608,297
	New Ideas		
	Mood Signature		
	Constellations and Love Situation		
	Music Valley		
Life and Sports	Encyclopedia of Health Fashion	5	439,609
	Daily Yoga		
	Cat is coming		
	Loving Fashion		
	Beautiful Trip		
Work Information	Sales Tactics	6	558,438
	Business personnel		
	Human Resources Management		
	Sales & Market		
	Financial Reference		
	Head News		

Table 5: Descriptive analysis of partial data items belonging to official accounts' articles

(a) Entertainment

Entertainment	Minimum	Maximum	Mean	Standard deviation
read	119	181022	11478.12	15379.368
like	0	3403	117.25	216.903

comment	0	936	22.30	41.598
add_to_favor	0	1790	56.74	101.040
sharing	0	10698	245.55	540.003
N				2847

(b) Emotion

Emotion	Minimum	Maximum	Mean	Standard deviation
read	474	100626	9151.07	9288.599
like	0	1150	47.39	76.182
comment	0	1066	16.70	33.461
add_to_favor	0	1223	35.94	68.698
sharing	0	3685	159.29	297.452
N				2948

(c) Life and Sports

Life and Sports	Minimum	Maximum	Mean	Standard deviation
read	112	122249	10234.50	9649.130
like	0	2906	229.58	316.696
comment	0	1001	30.86	60.216
add_to_favor	0	2317	79.75	158.043
sharing	0	8040	260.25	508.324
N				2590

(d) Work Information

Work Information	Minimum	Maximum	Mean	Standard deviation
read	65	218070	5942.90	9142.689
like	0	1054	23.92	51.623
comment	0	127	5.00	9.432
add_to_favor	0	3675	85.38	191.146
sharing	0	13181	283.44	581.124
N				2472

Annotation: “read”, “like”, “comment”, “add_to_favor”, “sharing” represent reading amount, praising amount, comment amount, the number of adding article to favorites, and sharing amount respectively.

Sample recognition

The follower amount of different official accounts varies greatly, and the reading amount of published articles varies greatly. The sharing amount is limited by the reading amount. Therefore, articles with a large reading amount are more likely to have a large sharing amount.

This paper studies the sharing amount based on the reading amount and defines it as sharing rate. The calculation formula is shown in formula (1).

$$sharing_rate_j = \frac{sharing_j}{reading_j} \quad (1)$$

In this formula, j denotes the No. j article. $sharing_rate_j$ is the sharing amount of the No. j article. $reading_j$ is the reading amount of the the No. j article. The scatter plot of sharing rate in the whole data range is shown in Figure 4. It can be seen that there are abnormal values, which may lead to great contingency and externality. Therefore, it is necessary to eliminate abnormal data in this study.

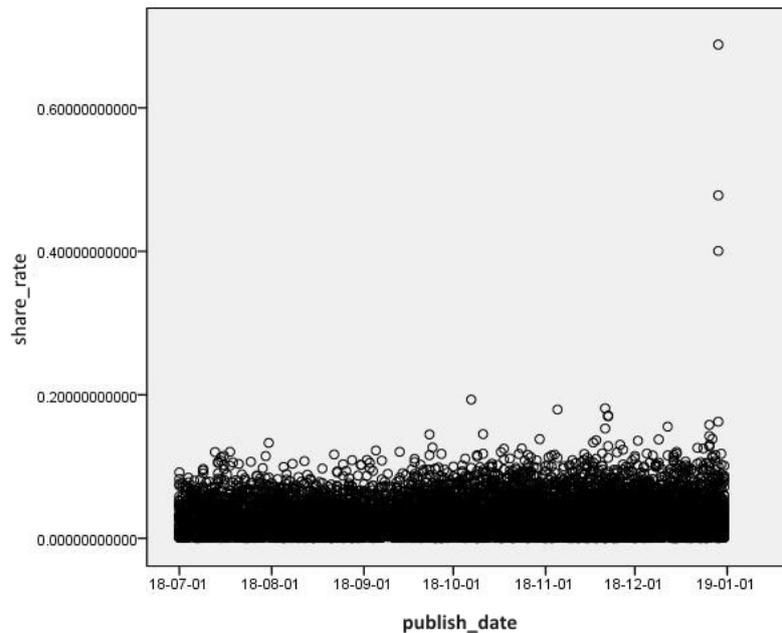


Figure 4: The scatter plot of sharing rate

The basic statistics of sharing rate after excluding outliers are shown in Table 6.

Table 6: Basic statistics of sharing rate

Sharing rate	Mean		.0261025232262
	Standard deviation		.02476798269887
	Minimum		0E-11
	Maximum		.19324090121
	Percentile	25	.0066921282412
		50	.0173247480017
		75	.0395813515349
	N		10854

It can be seen from Table 6 that the maximum sharing rate is 0.193, and the average sharing rate is 0.026. The upper quartile of the sharing rate is 0.0396. The above quartile can indicate the users' attitude to share to a certain degree. In order to calculate conveniently, the sharing rate of 4% or above is defined as high sharing, and the sharing rate below 4% is defined as low sharing. According to this definition, of the total 10,854 articles, 2,676 (25%) articles were high sharing, and 8,178 (75%) were low sharing.

ANALYSIS ON FACTORS AFFECTING SHARING ARTICLES

Characteristics of publisher

Official accounts' influence

The WeChat official accounts with larger reading amount have larger influence. Therefore, this paper considers five indicators, including follower amount, average reading amount, the largest reading amount, average sharing amount and the largest sharing amount. The WeChat official accounts' influence is calculated by different weights.

According to the entropy method, the weights are shown in Table 7.

Table 7: Weight of impact indicators

Indicator	Weight
Follower amount	0.1709
Average reading amount	0.1867
The largest reading amount	0.2016
Average sharing amount	0.2126
The largest sharing amount	0.2282

It can be seen from Table 7 that average sharing amount and the largest sharing amount have the largest weighting value of the influence score.

Type of official accounts

This paper considers that the type of official account (*wx_type*) has an impact on user's sharing behavior. The accounts of entertainment, emotion, life, sports and work information are marked as 1, 2, 3 and 4 respectively. The relationship between the four types and sharing rate is shown in Figure 5.

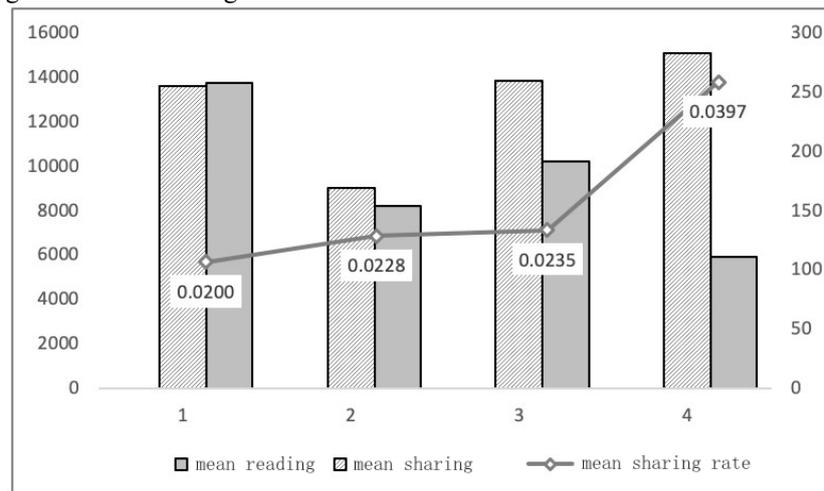


Figure 5: Relationship between account type and sharing rate

Authenticated or not?

This paper considers that whether it is authenticated (*wx_certified*) is another factor affecting sharing. If authenticated, *wx_certified* = 1, whereas *wx_certified* = 0. Table 8 is a basic description of unauthorized and authenticated account articles' sharing rates.

Table 8: A basic description of unauthorized and authenticated articles

	wx certified	N	percentage	average	standard deviation
share_rate	0	2522	23%	0.02704	0.02451
	1	8332	77%	0.02582	0.02484

Characteristics of recipient

We define the user of the WeChat official account as the recipient. Researches have shown that the higher the recipient's activity and the stronger interaction lead to the stronger willingness of sharing. From the perspective of recipient, the degree of interaction between recipient and publisher is expressed as recipient's commenting, sharing, liking, and adding to favorites.

Characteristics of Information

Title expression

This article divides the title into three types according to different ways of expression: direct (*title_type*=1); rhetorical (*title_type*=2); exaggerated (*title_type*=3) and incomplete type of words (*title_type*=4). Different categories are independent of each other. Table 9 compares the average sharing rates of titles expressed in different ways. It can be seen that direct and exaggerated titles account for more, and average sharing rates of these two types are relatively high, but the overall difference is not significant.

Table 9: Descriptive Statistics of Title Expressions

	title_type	N	percentage	average	standard deviation
share_rate	1	4315	39.8%	0.0281	0.0258
	2	2214	20.4%	0.0217	0.0216
	3	3794	35.0%	0.0271	0.0255
	4	531	4.9%	0.0208	0.0199

Picture proportion

The article is divided into three types: text-based (*img_ratio*=1), half-image-based (*img_ratio*=2), and image-based (*img_ratio*=3) according to the proportion of pictures from small to large. Table 10 shows the proportion of three types of articles and their sharing rates.

Table 10: Descriptive Statistics of Picture Proportion

	img_ratio	N	percentage	average	standard deviation
share_rate	1	1750	16.1%	0.0356	0.0277
	2	6345	58.5%	0.0264	0.0249
	3	2759	25.4%	0.0195	0.0201

From Table 10, we can see that most of the articles are in the form of half picture and half text, which is also the current popular arrangement mode. However, the higher proportion of pictures may lead to the lower average sharing rate.

Article length

In this paper, 0-500 words are defined as short text (text_words=1), users can read the text in one minute; 500-4000 words are medium text (text_words=2), users can read in less than 10 minutes; more than 4000 words are long text (text_words=3), users need to spend a long time for reading. The sharing rate data should be shown in Table 11.

Table 11: Descriptive Statistics of Article Length

	text words	N	percentage	average	standard deviation
share_rate	1	2111	19.4%	0.0176	0.0196
	2	7293	67.2%	0.0272	0.0247
	3	1450	13.4%	0.0330	0.0282

Table 11 shows that 500-4000-word medium-long text articles take up the majority, while the short and long text forms are relatively few, which is consistent with the reading habits of users.

Delivery time

Unlike other online social platforms, Wechat official account is designed to cultivate readers' reading habits. Generally, the delivery time is fixed in a day. Because of the different schedules of users from Monday to Sunday, there may be great differences in reading behavior, which may lead to fewer reading opportunities on Monday to Friday weekdays, and more on weekends. That is to say, the sharing rate in different days of a week is likely to be different. Therefore, it is worth exploring the effect of publishing date. Monday to Sunday are represented with 1-7, and the number of articles and sharing rate in a week are shown in Figure 6.

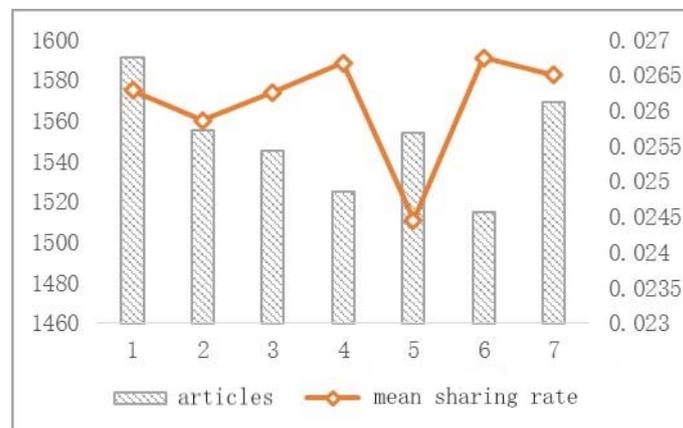


Figure 6: Number and sharing rate distribution of articles on different date

The picture shows that official accounts are mainly delivered on Monday and Sunday. Average sharing rate on Friday is the lowest in a week.

Article's position

Each official account can only deliver a message once a day. Each delivery is limited to six items. The first one is called "headline". Headline is not only at the top of delivery, but its card display enlarges the cover image, making it more attractive. Therefore, the reading and sharing amount of headline is generally higher than the others. Therefore, this paper regards article's location as one of the factors affecting user's sharing behavior. The integer 1-6 is used to represent the position order of the article in the current delivery. Fig. 7 is a scatter plot of the delivery position and sharing rate.

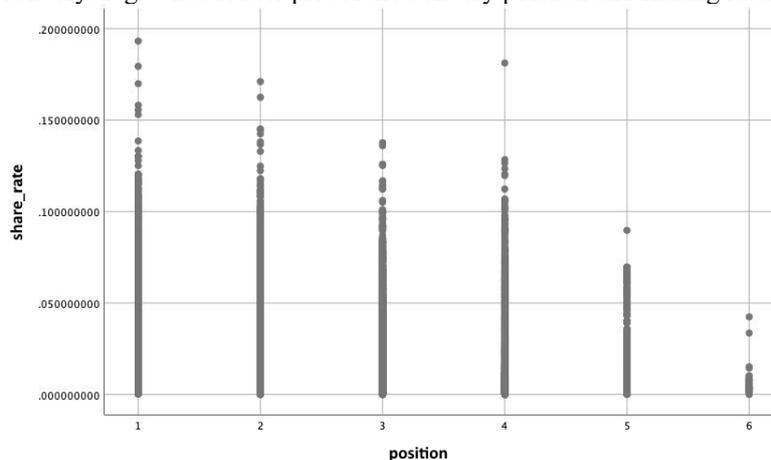


Figure 7: The scatter plot of delivery position and sharing rate

From Figure 7, it can be seen that the sharing rate decreases step by step as the delivery position moves backward, that is, the lower delivery position is, the lower sharing rate is.

Logistic regression analysis of influencing factors

This paper studies the influencing factors of WeChat articles' sharing, so the article sharing is set as the interpreted variable. According to what mentioned before, the interpreted variable is defined as the second categorical variable: high sharing (Share=1, sharing_rate \geq 4%) and low sharing (Share=0, sharing_rate $<$ 4%), so the article sharing problem is transformed into a typical two-class problem, and this paper considers to use logistic regression model to establish the relationship between sharing and influencing factors. According to the above analysis, the influencing factors are summarized as shown in Table 12.

Table 12: Summary of influencing factors on sharing

	Variable	Description	Source/Range of Value
Features of publishers	X_1	Influence power of account	Weighted Number of Fans, Articles, Readers and Sharers
	X_2	Account type	Entertainment=1, Emotion=2, Life and Sports=3, Work Information=4
	X_3	Whether is authenticated or not	Yes=1, No=0
Features of recipients	X_4	Interaction status	Mean amount of Comments, Sharing, Liking and Collecting
Features of information	X_5	Style of title	Direct=1, Rhetorical=2, Exaggerated=3, Unfinished=4
	X_6	Picture ratio	Text-based=1, Half picture and half text=2, picture-base=3
	X_7	The length of article	0-500 words, short article=1; 500-4000 words, medium-length article=2; more than 4000, long article=3
	X_8	Delivery time	The time when article is published
	X_9	Delivery data	Mon.=1, Tue.=2, Wed.=3, Thu.=4, Fir.=5, Sat.=6, Sun.=7
	X_{10}	Article position	The first=1, the second=2, the third=3, the fourth=4, the fifth=5, the sixth=6, the seventh=7

Collinear Diagnosis

Before performing logistic regression analysis on the data, a multi-collinearity test is first performed on the selected influencing factors. It can be directly judged according to the correlation coefficient between independent variables. When the correlation coefficient approaches 1, it means there is a strong correlation. Pearson correlation coefficient of sharing factors are shown in Table 13 by using SPSS software.

Table 13: Correlation coefficient of explanatory variable

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
X_1	1									
X_2	-0.01	1								
X_3	0.42	-0.01	1							
X_4	0.50	-0.12	0.31	1						
X_5	0.01	0.04	0.00	0.04	1					
X_6	0.09	-0.29	0.17	0.11	0.20	1				
X_7	-0.16	0.19	-0.16	-0.09	-0.14	-0.62	1			
X_8	-0.26	-0.07	-0.02	-0.18	-0.12	-0.12	0.08	1		
X_9	0.00	0.00	0.00	0.01	-0.01	0.00	-0.01	0.05	1	
X_{10}	0.23	0.00	0.21	-0.36	-0.01	0.19	-0.27	-0.04	-0.02	1

The absolute value of correlation coefficient between most variables is small, but the correlation coefficient between the image ratio and the length of the article reaches -0.62. Therefore, the multicollinearity test is continued by using the tolerance (TOL) and variance expansion factor (VIF) indicators. The value is defined as:

$$TOL_{(j)} = 1 - R_j^2 \quad (j = 1, 2, \dots, m) \quad (2)$$

Among them, R_j is the correlation coefficient between the independent variable and other $m-1$ independent variables. If there is serious collinearity, that is $R_j \approx 1$, there is $TOL_{(j)} \approx 0$. Generally speaking, a tolerance of less than 0.2 can be considered as a sign of the existence of multiple collinearity. The variance expansion factor is the reciprocal of the allowable value. Normally, when $VIF \geq 5$, it can be considered that there is collinearity between the independent variables. The collinearity statistics of independent variables are shown in Table 14.

Table 14: Collinearity statistics of explanatory variables

Variable	Tolerance	Variance Expansion Factor
X ₁	0.514	1.946
X ₂	0.877	1.14
X ₃	0.742	1.348
X ₄	0.454	2.204
X ₅	0.939	1.064
X ₆	0.547	1.83
X ₇	0.579	1.728
X ₈	0.996	1.004
X ₉	0.887	1.127
X ₁₀	0.552	1.81

Since the tolerance of all variables is greater than 0.2, the variance expansion factor is less than 5, so there is basically no multicollinearity problem between the explanatory variables affecting the sharing, and all variables can be included in the regression model.

Logistic regression model construction

In this paper, 10 factors are extracted from the three dimensions of publisher's feature, recipient's and information's as explanatory variables, and the sharing is used as the dependent variable to construct the regression model. According to the previous analysis, the sharing is a binary categorization variable. When the value is 1, it is high sharing, and when it is 0, it is low. Therefore, this analysis of the factors affecting sharing is a discrete selection problem. Given independent variable X_1, X_2, \dots, X_n , if $P(P \in [0, 1])$ is the incidence of high sharing, then $1 - P$ is the incidence of low sharing. So the binary logistic regression model is defined as:

$$\text{Logit}(P) = \ln \left[\frac{P}{1-P} \right] = \beta_0 + \beta_1 X_1 + \dots + \beta_n X_n \quad (3)$$

In the formula, $P/(1-P)$ is a ratio, that is, the probability of an event occurring to the probability of non-occurrence. This paper refers it to the ratio of incidence of high sharing and low sharing. β_0 is a constant term, β_i represents the regression coefficient of each variable. When β_i is a positive value, it means each factor has a positive influence on sharing; when β_i is a negative value, it has a negative influence.

Through the operation it can be obtained:

$$P = \frac{1}{1 + \exp[-(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_m X_m)]} \quad (4)$$

This is consistent with the sigmoid function, it also reflects the nonlinear relationship between the probability P and the dependent variable. Limited to 0.5, when $P > 0.5$, it is classified as high sharing; otherwise classified as low sharing.

Logistic regression model results analysis

According to the established model, this paper uses SPSS 25.0 to realize the calculation of this model. Table 15 shows the overall fitting effect of this model, in which the chi-square ratio statistic is 2992.546 and $P=0.000<0.05$ meaning it reaches a significant level and indicating that at least one of these explanatory variables is a model pair. The correct percentage of the overall classification of this model is 74.8%, indicating that this regression model has higher accuracy.

Table 15: Test of Logistic regression fitness

Chi square	Log likelihood	Cox & Snell R^2	Nagelkerke R^2	Percentage of correctness
2992.546(0.000)	10881.046	0.241	0.334	74.8%

In this paper, the Backward LR method of logistic regression is used to estimate the model parameters, that is, all variables are entered into the regression equation, and then the independent is eliminated whose value of the p is maximum according to the probability value of the maximum likelihood estimation statistic. This process is repeated until remaining independent variables are significant. In the first step, all variables enter the regression test and the results are shown in Table 16.

In Table 16, B and Sig respectively represent the regression coefficient and the significance level, and Wald is used to test whether the independent variable has an influence on the dependent variable. The larger the Wald value is, the more significant the effect is. Exp(B) is an odds ratio (OR value), which indicates the change ratio of the event occurrence ratio caused by each unit of the independent variable when the other conditions are unchanged.

Table 16: Logistic regression results of variables

Variable	B	S.E	Wald	df	Sig	Exp(B)
X_1	0.285	0.011	719.272	1	0.000	0.752
X_2			1152.752	3	0.000	
X_3	0.906	0.09	101.547	1	0.000	2.475
X_4	2.697	0.078	1201.092	1	0.000	14.839
X_5			84.17	3	0.000	
X_6			2.567	2	0.277	
X_7			52.682	2	0.000	
X_8	0.040	0.016	6.495	1	0.011	1.041
X_9	0.002	0.012	0.024	1	0.876	1.002
X_{10}	-0.326	0.026	156.885	1	0.000	1.386
Constant	-3.443	0.365	88.746	1	0.000	0.032

Except the independent variable picture ratio and delivery date, the other 8 variables have significant effects on the dependent variable ($P<0.05$). After 2 rounds of optimization test and screening, the final variable regression results are obtained, as shown in Table 17.

Table 17: Logistic regression results of the optimized variables

Variable	B	S.E	Wald	df	Sig	Exp(B)
X_1	0.285	0.011	720.49	1	0.000	0.752
X_2			1299.789	3	0.000	
X_3	0.905	0.09	101.631	1	0.000	2.473
X_4	2.698	0.078	1202.788	1	0.000	14.854
X_5			85.904	3	0.000	
X_7			99.977	2	0.000	
X_8	0.040	0.016	6.4	1	0.011	1.041
X_{10}	-0.325	0.026	156.143	1	0.000	1.384
Constant	-3.298	0.353	87.137	1	0.000	0.037

After optimization test, we can know that type, authentication, user interaction degree, title expression, article length, delivery time and position are significant for sharing ($P < 0.05$).

The influencing factors can be summarized as follows from three aspects: characteristics of publisher, characteristics of recipient and characteristics of information.

(1) Characteristics of publisher

From the regression results, influencing power, account type and whether is authenticated have a significant impact on sharing behavior. Among them, influencing power has a positive impact on sharing rate ($B=0.285$). From the perspective of the OR value, sharing rate will increase by 0.752 times for each unit increase of official accounts' influence. It indicates that the greater influence of the official account have, the more easily shared.

An authenticated account's articles is easier to be shared than articles published by the unauthenticated. From $EXP(B)=2.473$, the sharing probability of an article belong to an authenticated account is 2.473 times than an unauthenticated account's.

Compared with work information one official account type, entertainment, emotion, life and sports have lower sharing influence. The possible reason is that WeChat has strong working attributes. Therefore, they express their work sympathy or acquire professional skills through sharing behavior.

(2) Characteristics of recipient

Table 5-12 shows that the regression coefficient of the "user interaction degree" variable is 2.698, indicating that user interaction has a significant positive impact on sharing. For each unit of user interaction, the sharing probability increases by 14.854 times. Therefore, cultivating user interaction is one of the channels that lead to high sharing.

(3) Characteristics of information

Parametric regression results show that only the title expression, article length, delivery time, and delivery position have a significant impact on sharing. Among them, the "direct" title is more likely to produce high sharing than other expressions.

For the length of the article, 500-4000 words are most likely to produce high sharing. It is the best for touching users that the article is moderately long, the text is between 500 and 4000 words, and the reading time is about 10 minutes.

The article's position has a negative influence on sharing. The lower delivery position, the worse sharing effect. The probability of high sharing decreases by 1.384 times with the article ratchets down another notch. This is related to the way operator arranges the content. The headline delivery display is more conspicuous, so the operator should put higher quality content.

The effect between image scale and sharing is not significant, which may be related to the way users read article. Unlike the short and fast reading mode of Weibo, WeChat articles are relatively long, and users pay more attention to the content.

SHARING PREDICTION MODEL AND EXPERIMENTAL ANALYSIS

Prediction Model Construction

Logical Regression Model

In this logistic regression analysis, the dependent variable Sharing is a dichotomous variable whose values are $Sharing=1$ and $Sharing=0$, representing high sharing and low sharing respectively. The independent variables that affect the value of Sharing are x_1, x_2, \dots, x_m . The logistic regression model can be expressed as:

$$f(x, \beta) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x_1 + \dots + \beta_m x_m)}} \quad (5)$$

In equation (5), $\beta = (\beta_1, \beta_2, \dots, \beta_m)$ is the parameter of this model, namely the regression coefficient. X_i is the No. i eigenvalue of the record X , and m is the number of features. The logistic regression model is used to calculate the regression parameters: suppose the probability that an article is high sharing is $f(x, \beta)$; then get the probability that the text is low sharing is $1 - f(x, \beta)$. The probability of Y under conditions of X and β is shown in the equation (6):

$$P(y | x, \beta) = \begin{cases} f(x, \beta), & y = 1 \\ 1 - f(x, \beta), & y = 0 \end{cases} \quad (6)$$

The possibility obtained from the entire training set can be expressed as follows:

$$P(X, y, \beta) = \prod_{i=1}^N f(x^i, \beta)^{y_i} (1 - f(x^i, \beta))^{1-y_i} \quad (7)$$

Logarithm of equation (7) can be transformed to:

$$\ln P(X, y, \beta) = \sum_{i=1}^N \left(y_i \ln f(x^i, \beta) + (1 - y_i) \ln (1 - f(x^i, \beta)) \right) \quad (8)$$

x^i is the No. i record in data set X , y_i is the classification result of the No. i record, and N is the number of records in the training set. This logistic regression model parameters can be obtained by calculating the maximum value of $\ln P(X, y, \beta)$, based on the maximum likelihood estimation method and iterations until convergence.

Support Vector Machine Model

In general, linear separable data is relatively rare. For linear inseparable samples, kernel function is generally introduced to map them to higher dimensions to solve the problem. Therefore, this paper introduces the kernel function to construct the prediction model. Table 18 lists several commonly used kernels.

Table 18: Common Kernel Functions

kernel function	Expression	Explain
Linear Kernel Function	$\kappa(x_i, x_j) = x_i^T x_j$	Linear separable support vector machine
Polynomial Kernel Function	$\kappa(x_i, x_j) = (x_i^T x_j)^d$	One of the commonly used kernel functions of linear inseparable SVM
Gaussian Kernel Function	$\kappa(x_i, x_j) = \exp\left(-\frac{\|x_i - x_j\|^2}{2\sigma^2}\right)$	The most mainstream kernel function of nonlinear classification SVM
Sigmoid Kernel Function	$\kappa(x_i, x_j) = \tanh(\beta x_i^T x_j + \theta)$	One of the commonly used kernel functions of linear inseparable SVM

Input: The training sample is $(x_1, y_1), (x_2, y_2), \dots, (x_m, y_m)$, where x is the m -dimensional eigenvector and y_i is the binary output with a value of +1 or -1.

Output: Separate hyperplane parameters and decision functions.

The algorithm process is as follows:

(1) Construct the constrained optimization problem by selecting the appropriate kernel function and the penalty factor C .

$$\begin{aligned} \max_{\alpha} \quad & \sum_{i=1}^m \alpha_i - \frac{1}{2} \sum_{i=1, j=1}^m \alpha_i \alpha_j y_i y_j \kappa(x_i, x_j) \\ \text{s.t.} \quad & \sum_{i=1}^m \alpha_i y_i = 0 \\ & 0 \leq \alpha_i \leq C \end{aligned} \quad (9)$$

(2) Solving with SMO algorithm, and obtaining the corresponding α^* vector with the minimum formula.

(3) Find out that all S support vectors satisfying $S = \{i \mid 0 < \alpha_i < C, i = 1, 2, \dots, m\}$, solve equation (10) to get b corresponding to each support vector (x_i, y_i) , and b^* is the average of all b , as expressed in equation (11).

$$y_s \left(\sum_{i \in S} \alpha_i y_i \kappa(x_i, x_j) + b \right) = 1 \quad (10)$$

$$b^* = \frac{1}{S} \sum_{s \in S} \left(y_s - \sum_{i \in S} \alpha_i y_i \kappa(x_i, x_j) \right) \quad (11)$$

The final classification model is

$$f(x) = \sum_{i=1}^m \alpha_i^* y_i \kappa(x_i, x_j) + b^* \quad (12)$$

In the process of training model, different kernel functions and parameters are used for comparative training in order to get the most suitable kernel functions and parameters. In actual operation process, the best is to use Gaussian kernel function, with the gamma value of the kernel function parameter is 0.1 and the penalty coefficient C is 4.

Analysis of Experimental Results

Evaluation Indicators

In order to evaluate the effectiveness of the sharing behavior prediction model, this paper uses the commonly used evaluation indicators of classification algorithm: Accuracy, Precision, Recall, F_1 (F_1 score):

$$Accuracy = (TP + TN) / (TP + FP + FN + TN) \times 100\%$$

$$precision = TP / (FP + TP) \times 100\%$$

$$recall = TP / (TP + FN) \times 100\%$$

$$F_1 = 2 \cdot \frac{precision \cdot recall}{precision + recall}$$

Where TP represents the sample size predicted to be high sharing and actually high sharing; FP represents the sample size predicted to be high sharing but actually low sharing; TN is the sample size predicted to be low sharing and actually low sharing; FN is the sample size predicted to be low sharing but actually high sharing.

ROC curve is drawn in the form of curve with sensitivity (TPR) as ordinate and specificity (FPR) as abscissa. The larger the coverage area under ROC curve is, the better the prediction accuracy is and the better performance of the prediction model is.

Comparison of experimental results of classification algorithm

According to the characteristics shown in Table 12, the logistic regression model and the support vector machine model are respectively used for training and prediction, and then the prediction results are evaluated. The confusion matrix is shown in Table 19. The values of accuracy, precision, recall and F_1 in these two models are shown in Table 20. The ROC curve is shown in Figure 7.

Table 19 Prediction result confusion matrix

		Predictive high sharing	Predictive low sharing
Logistic Regression	Actual high sharing	550	2377
	Actual low sharing	230	589
Support Vector Machine	Actual high sharing	625	162
	Actual low sharing	132	687

Table 20 Comparison of experimental results

Prediction model	Accuracy	Precision	Recall	F_1 score
Logistic Regression	0.709	0.713	0.719	0.716
Support Vector Machine	0.817	0.809	0.839	0.824

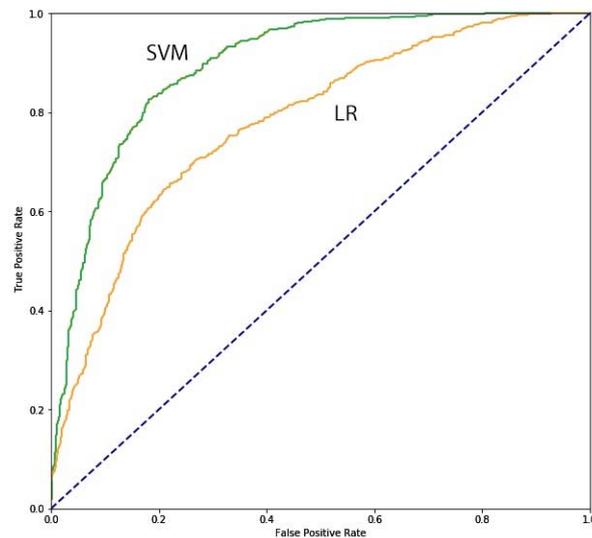


Figure 7: ROC Curves of Different Models

From Table 20, it can be seen that the prediction accuracy of support vector machine is 81.7%, while the prediction accuracy of logistic regression is only 70.9%. In terms of each evaluation index, support vector machine is superior to logistic regression model. What's more, it can be seen that the coverage area under the ROC curve of the support vector machine (SVM) model is larger, which indicates that the prediction accuracy of the SVM model is higher and the model performance is better.

In order to further verify the validity of the Gaussian kernel function selected in the support vector machine model, this paper selected three other different kernel functions for comparative experiments, and calculated the results of each evaluation index as shown in Table 21.

Table 21: Prediction results of different kernels

	Accuracy	Precision	Recall	F_1 score
Linear Kernel Function	0.721	0.717	0.737	0.727
Polynomial Kernel Function	0.797	0.796	0.803	0.800
Gauss Kernel Function	0.817	0.809	0.839	0.824
Sigmoid Kernel Function	0.573	0.579	0.559	0.569

Characteristic Importance Comparison

In order to further investigate the impact of various features on the prediction results of users' sharing behavior, this paper presents some features that have significant effects on the dependent variable after using full features respectively, and the prediction results after removing some types of features, are as shown in Table 22.

Table 22: Prediction effect of different features

	Accuracy	Precision	Recall	F1-score
Use all features	0.817	0.809	0.839	0.824
Using optimized features	0.832	0.818	0.862	0.839
Unused Publisher Characteristics	0.729	0.722	0.762	0.742
Unused recipient characteristics	0.737	0.734	0.761	0.747
Unused information features	0.752	0.758	0.755	0.756

SUMMARY AND PROSPECT

This paper takes the WeChat official accounts as research object, draws lessons from researches that are relatively mature and focus on microblogs' sharing, extracts the possible influencing factors from the three dimensions: information publisher, information recipient and information characteristics. With the support of some official accounts' real operation data, we explore the influence of various factors on users' sharing behavior.

What this study have found are as follows. First, account influence, account type, and whether account is authenticated in the characteristics of the information publisher have a significant effect on sharing. Compared with the official accounts of entertainment, emotion, life and sports, the official accounts of work information deliver articles with high sharing probability. Second, the interaction between users and WeChat official accounts has a significant positive impact on sharing behavior. That is, the higher the interaction is, the higher the probability of sharing is. Third, title expression, article length, delivery time and

delivery position in information features importantly determine sharing. Fourth, the characteristics of publisher, recipient and information have great influence on sharing, and the importance is not different.

Without doubt, there are still many shortcomings in this study. Based on the existing research results, we can further study and improve the following two aspects in the future. First, the influencing factors in this paper are mainly constructed from three aspects: official accounts' features, users' features and information's features. However, due to the technical limitations, the text content characteristics of the article are not taken into account. In addition, other factors including the originality of the article and the frequency of delivery should also be considered. The improvement of indicators will be the focus of future research. Second, this paper defines the threshold of high sharing and low sharing, and takes it as a classification variable. For the validity of the whole experiment, the definition between high sharing and low sharing is very important. In the future, the boundary value will be adjusted to obtain the optimal boundary value.

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Research on Application of Kansei Image of Culture in Big data of Product Design

(Full Paper)

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ABSTRACT

In pursuit of internationalization and globalization, the multinational corporations have begun to take into account the cultural differences between different regions for their product design and marketing strategy. This paper further clarifies the difference between the Kansei preferences and tendencies of consumers through the discussion on the relationship between products and the Kansei demand of consumers with different cultural backgrounds. In addition, in this paper, the Kansei demand of consumers will be learned through collecting the Kansei images of customers with different cultural backgrounds and learning about the differences of Kansei image affected by different cultural backgrounds and the Kansei factors such as the thoughts and feeling preferences of consumers under the influences of local cultures. Then, the factors affecting the Kansei demands of consumers with different cultural backgrounds are correctly analyzed, which will be helpful for the designers to master these design elements and apply them into product shape and functions, thereby designing the products that meet the consumers' expectations and improving the additional values of the products.

Keywords: Big data, Innovation language, Culture, Kansei image, Product design

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INTRODUCTION

Innovation language of product design is no more a new topic, but innovation language is forever a target pursued by designers in their research and development of new products. The reason why today's enterprises are confused in their research and development of new products is nothing. But the rapid development of science and technology, it has brought a new bottleneck to their product development. On the other hand, consumers have increasingly high requirements on products with the progress of the times. Design requirements have also changed. After consumption shifted from product-orientation to customer-orientation, the concept has emerged where consumption is led by design.

A good design can transform our feelings, consciousness and future science and technology in the environment into design elements and endow the products with a new design language, which is an embodiment of future values. Will designers realize factors of a concept, organize the data and create a concept in their sub-consciousness? There must be some creative language. The conceptual application of product design cannot avoid the "language". In some sense, concept is also language and can only be expressed with language. As long as a concept is applied in conceptual design, language must be used. Particularly when different is used to express a new concept, a language needs to be invented. In product design, we not only use simple daily language to create expressions, but the development of a new concept itself is a painstaking process. When related highly abstract terms of each field are involved, it is important to combine the terms that make you feel good. At the beginning of product design, the terms for the development of a concept are used to express the creative thinking. This requires a mood like the original impression sketch for the "invention of a new language". This is also what of innovation language needs to be studied by product designers.

FORMATION OF CONCEPTS WITH NEW LANGUAGE OF PRODUCT DESIGN

By analyzing the cognitive theories for product modeling and creating new and diversified imaginations of the future, product semantics explores the possible future with foresight and systematic research. In designing products, it is combined with the research theoretical architecture of ergonomic system. Through design survey, the data undergoes preliminary statistical analysis, factor analysis and clustering analysis. Under the model of quantitative analysis, the perceptual image in the heart of customers will be explored, thus positioning the perceptual image in product design.

Product semantics is a science studying the significance of product language. Its theoretical architecture can date to the "research on symbol application" of Germany Ulm Institute of Design in 1950 and can even be traced to the theory of mark initiated by Charles and Morris from Chicago New Bauhaus Institute of Design. The concept was explicitly initiated by Professor K. Krippendorff of the US and Professor R. Butter of Germany in 1983, which was defined in "Product Semantics Symposium" held by IDSA at Cranbrook Academy of Art of the US in 1984: Product semantics is a science studying the symbolic characteristics of the forms of artifacts in the use scenarios and how they are applied in industrial design. It has departed from the conventional design theory that simply classifies human factors to ergonomics, widened the category of ergonomics, and not just considered physical and psychological functions of human as in conventional ergonomics, but introduced design factors to our psychology, processing technology and uses of technology. As the society develops and progresses, materials become extremely diverse and the levels of consumption are further refined, our demand for the spiritual

functions of products will grow. Other than conveying its functions, product's model will also convey the cultural connotation of a product through its semantic characteristics and reflect the modernity and value orientation of a specific society. Just as Pierre Guiraud, a famous French symbolist said, under a lot of circumstances, we are not buying specific products, but are hunting for the symbols of fashion, youth and success.

Generally the conceptual design language of products promotes our current demands from the perspectives such as futurology, ergonomics, design psychology and logic. Thus products suitable for our demands in the future will be created. In terms of the relationship of request and reliance between the human and the nature, scientific methods such as timing, quantitative and qualitative ones are employed to explore the rational positioning of human society development by modern science and technology. The track of human development is affected by its ideology. In the position study of perceptual image in future product design, perceptual language of futurology is extracted and employed in design.

IMAGE EXPRESSION OF CULTURAL SEMANTICS IN PRODUCT DESIGN

"Culture" is a common term in daily life. In China, the term "Culture" refers to the meaning of humanistic education; while in the West, the semantic difference between Culture and Civilization was not clear until the 19th century. But no matter in the East or in the West, there is no obvious standard definition of the term "Culture".

Relevant Discourses In The East

According to the saying *Ci Hai*, Culture refers to "Culture and Education". It is interpreted in general terms as "Human society from barbarism to civilization, the achievements of its efforts, and are manifested in science, art, religion, morality, law and customs, habits and other complexes, which is called Culture".

The term "Culture" is mentioned in the book of Cultural Anthropology (Liu, 1991). Although it has a wide meaning in modern science, culture can be referred to as a combination of politics, economy, belief, morality, art, literature, customs and all the abilities and habits to become a part of society. From this point of view, culture and human life are inseparable, it can also be said that culture is a set of inherent life style generated by a group to adapt to the environment.

Semiotics is a phenomenon in which social and cultural phenomena are grasped as symbols and explore the meaning hidden behind it. Scholar believes that when symbols involve language, utensils, tools, symbols, works of art and human behaviors, these symbols will constitute the hardware and software of a society, thus constitute a cultural world (Li, 1998).

Another scholar, defines culture as a kind of essential existence, whose role permeates all human social relationship patterns, religious beliefs and behavior patterns, as well as various objects and tools it produces and use (Chen, 2002).

Relevant Discourses In The West

According to the saying Cambridge Encyclopedia, culture is the lifestyle of a group, which includes behavior pattern and ideas handed down from generation to generation, such as the group's beliefs, values, languages, regimes, economic activities, as well as instruments, technologies and art forms.

Scholar E. B. Taylor (1871) defines the overall meaning of culture as: "Culture contains a complex whole of all kinds of knowledge, beliefs, art, morality, law, customs and any abilities and habits that other people required as members of society." This complex whole simply means that it represents people's lifestyle, which is a combination of acquired behavior patterns, ideas, attitudes and artifacts (Hall, 1959 & Hofstede, 1997). Culture can also be a way of solving problems between communities, through collective thinking and taking joint actions to solve problems in daily life (Trompenaars, 1998).

Thomas (1985) defines culture from the cultural concept of history. Culture as a descriptive concept can refer to the accumulation of wealth created by human beings: books, paintings, architecture and so on. Through generations of people, language, customs, etiquette system, ethics, religion and morality are established. From the above viewpoints, culture is formed by historical experience, values, traditions and environment. Culture influences how people behave, look at the world, how to express themselves and how to think (Ever, 2001).

In the research of cross-cultural field, scholar Marcus (2001) proposed in the user interface research that when the term "Culture" is used in relevant researches, its cultural significance is mostly related to "Lifestyle".

In summary, although there is no standard definition of culture, it can be found from the interpretations and opinions of these scholars at home and abroad that, broadly speaking, "Culture" refers to "Lifestyle". Lifestyle becomes the culture through the accumulation of the time, and culture is presented by the lifestyle and the way of using objects. Therefore, in the cross-cultural research, in order to clarify the essence of cultures in different countries, we can cut-in from the lifestyles of different countries and to understand their cultural differences. The cross-culture of this study is to conduct the cross-cultural research on the most representative mobile phone products in the lifestyle. It can further summarize the similarities and differences by virtue of the views, perceptions and preferences of different cultures on the use of mobile phone products.

Products can convey two kinds of information to people, one is rational and informative information, such as product function and material itself; the other is perceptual information, such as product shape, color, usability and so on. Simply put, the information conveyed by the external shape of the product is not only a pure visual aesthetic feeling, but also carries value judgment, operation function, cultural information, brand image and so on. Krippendorff & Butter (1984), a scholar of product semantics, interprets the product semantics as “The implied meaning and symbol of the object in the psychological and social use level”, and believes that designers should pay more attention to and consider the environmental symbols in the cultural, social and psychological levels when designing products.

Dejan & Souza (1998) put forward the relationship among designers, consumers and products, and define it at the cultural level. They believe that the cultural background elements of consumers will have an impact on design, and emphasize the interaction between culture and products. Therefore, design is not only the knowledge and imagination of designers, but also the cultural concepts of designers when they are engaged in design, which comes from the understanding of consumers' lifestyle and affected by their cultural backgrounds.

Robert Melody A (2001) puts forward a cross-cultural perspective in the article of Border Crossing and explore the changes in the behavior and value of successful products for users through research. He believes that to globalize the products, it is necessary to break down the boundaries and differences of borders on race, society, and culture and also believes that it can stimulate better design through the study of different cultures and understanding the demand of consumers for products.

Saint (1993), a scholar at the Royal Melbourne Institute of Technology (RMIT) in Australia conducted the quality analysis of products from different countries and summarized the conclusions as shown in Table 1.

Table 1: Quality Analysis of Products in Different Countries (Data Source: Cai, 1994)

Country	Product Quality Description
Germany	Precise, reliable, scientific, status, position, superiority. The complex and rigorous structure of German makes its thinking very organized, and so does the life culture.
USA	High-tech, practical rural atmosphere, western spirit, large size, gorgeous, exaggerated, gorgeous. The vast territory and abundant resources form its arrogant attitude focus on packaging and colorful entertainment.
France	Noble fashion style and style.
Italy	Showy, avant-garde, surprising and inspired by designers. Religion makes it bold, and family values make it a special taste in its traditional craftsmanship.
Japan	Delicate, lightweight, detail-oriented, value-for-money. Its decision-making mode belongs to the crowd brainstorm and considers it highly detailed.

The product design in different countries is deeply influenced by their culture. Over the accumulation of the time, unique cultural aesthetics have been formed. Local people also have a set of their own aesthetic appreciation standards for products. According to the design culture of different countries, we can clearly distinguish the differences between European and American countries and Asian countries. However, as the world tends to understand the eastern culture, the aesthetic standards of product appreciation will be different for the representatives of the both sides of the Straits, Japan and Korea, even if Asian countries and East Asian cultural circle.

How to systematically analyze and explain the connotations of different cultures has always been the goal of scholars. Scholar Hofstede (1997) believes that there are quite obvious differences in people's attitudes, tendencies, emotions and expressions among different countries or nationalities, and these differences are rooted in culture.

Cultural Dimensions

In order to understand the traits of different cultures, Hofstede studied the cultural features of IBM employees in 64 countries from 1978 to 1983. The research results show that there are patterns for cultural differences in different countries. Hofstede believes that the differences originate from different values. Therefore, it is described as five Cultural Dimensions as follows:

- (a) Power Distance: Refers to the degree to which people respect and accept the unequal phenomenon of power distance in a culture. A culture with a high power gap tends to be centralized and vice versa, to be equal.
- (b) Individualism vs. Collectivism: Refers to the degree to which people define themselves in terms of the group or organization they belong to in a culture. It refers to the tendency toward Individualism or Collectivism in the culture.
- (c) Masculinity vs. Femininity: Refers to the degree to which people distinguish between roles and expectations of both sexes in a culture. Masculine culture refers to the traditional gender difference traits, rational, extroverted and oriented to substantial interests; Feminine culture refers to break down gender differences and overlap gender roles, emotional, family-oriented, introversion and affection.
- (d) Uncertainty Avoidance: Refers to the extent to which most people prefer to deal with unclear and unpredictable situations

with formal and explicit activities in a culture. The higher the score of Uncertainty Avoidance, the more the ethnic group tends to be satisfied with the status quo and tends to escape unclear things.

- (e) Long-Term Orientation vs. Short-Term Orientation: Refers to the extent to which people are influenced by certain values such as thoughts for a long time in a culture, that is, the degree to preserve their own cultural and etiquette traditions. Taking Asian countries as an example, Confucius's Confucianism occupies an important position.

Table 2: Hofstede's Dimension of Culture Scales
(Data Source: <http://www.geert-hofstede.com/>, 2003)

Culture	Power Distance	Individualism	Masculinity	Uncertainty Avoidance	Long-Term Orientation
	PDI	IDV	MAS	UAI	LTO
China	80	20	66	30	118
Japan	54	46	95	92	80
South Korea	60	18	39	85	75
Taiwan	58	17	45	69	87
USA	40	91	46	62	29
Asia(China, Japan, Korea, HK)	60	24	55	60	85
World	55	43	50	64	45

From Hofstede's research results, as shown in Table 2 above, we can find that in the PDI dimension, China has the highest score, which reflects that China's current society is still inclined to centralization; in the IDV dimension, Japan has the highest score, which indicates that Japanese nationality tends to individualism; in the MAS dimension, Japan has the highest score, which indicates that Japanese society tends to be masculine and rational. In addition, Taiwan tends to be both emotional and rational in this part; in the UAI dimension, the scores of Japan and Korea are higher, which shows that Japanese and Korean nationality tend to be satisfied with the status quo in the face of uncertainty avoidance; in the LTO dimension, the scores of all four countries are quite high, which clearly shows the extent to which countries in Asian region have been influenced by traditional ideas for a long time.

Cultural Dimension Theory is widely used in the analysis of differences between countries. In the study of how cultural factors affect interface design, Scholars Evers & Day find that cultural preferences do affect users' acceptance and satisfaction for products.

Cultural Marker

Different from the viewpoint of cultural dimensions, scholars Barber & Badre (1998) defined the term "Cultural Marker" in the study of cultural features in interface design, which refers to commonly used and possibly preferred interface design elements in the certain ethnic groups. Cultural markers can be regarded as the individual feature markers of interface design elements, including colors, fonts, symbols, etc. It is believed that cultural markers will directly affect the user's operational efficiency. Therefore, through the identification and analysis of cultural markers, it will help to understand the differences in the interface design between different cultures.

THE ROLE OF NEW LANGUAGE IN R&D OF PRODUCTS

The research of future design leads consumption. For the R&D of products, this is actual an issue of contemporary culture and technological creativity. Viewed from today's design, designers must have a deep insight of the entire society's cultural background and have a clear knowledge of the development status of such areas as politics, economy, technology, national culture, the people's aesthetic accomplishment and international exchange. (shown as Table 3)

Table 3: Analysis and Its Basis Theory
(Data Source: Collated by This Research)

Analysis Item	Basis Theory	Analysis Method
Values	Cultural Dimensions	Research, In-depth Interviews and Field Study of Relevant Scholars
Preference of Visual Elements	Cultural Marker	The Eye-catching Features of the Products Selected by the Audiences
Perceptual Demand of Product Image	Kansei Engineering	Sensory Assessment of Adjective Vocabulary by Audi

Designers should think of the trend of design. Only from this height can they grasp the development trend of society. But the guidance of the trend is usually difficult for us to grasp and predict, which results in the lagging of a series of links of products

such as R&D, production, sales and feedback. Futurology and ergonomics, two emerging scientific knowledge system will provide us with certain help. The two theories are taken as objects of research and practice and are applied in the R&D of future product design to solve the human's confusion in life and work and grab the early opportunities of the market.

For example, the form design language of products is an important way to create images of products, which can create a certain atmosphere through the dimensions, shapes, proportions of products and their mutual relationships, thus arousing different emotions such as exaggeration, implication, fun, joy, relaxing and mystery in customers so that they will have a psychological experience and feel a sense of intimacy and success, and a certain image of the products can be established. A symmetrical right-angled geometrical shape can highlight the preciseness of a structure, which can create a solemn, peaceful, elegant and lively atmosphere. A round can highlight the concept of harmony, sameness and inclusiveness and create a complete and free atmosphere. A curve can create a dynamic model and make the audience feel the strength of life, which can create a heated, free and warm atmosphere. A free curve is close to the natural form and full of life elements, which can create a simple, natural and environment-friendly atmosphere. A smooth curve is properly flexible, with rigidity in flexibility, which is suitable for the rhythmical and simplistic effects pursued in modern design. The unusual asymmetrical beauty can create a magical effect and bring an extremely great visual shock and avant-garde sense of art to the audience. With model methods such as variation and asymmetry, we can create an avant-garde and pioneering atmosphere. The symbolic significance of modeling semantics is also reflected in such aspects of products as rank, quality, fun and fashion. To name some examples, exquisite details can reflect the excellent quality and craftsmanship of the products. Through the overall modeling and locality modeling, the grade and uniqueness of a product can be reflected. In the design of electrical appliances, machinery and hand tools, the modeling semantics can also express the symbolic significance of safety. The complete and plump overall form, the structure with a fine workmanship and detail treatment will all bring a sense of safety. A rational size and a safe design to avoid wrong operation will make one feel safe psychologically and physiologically.

Table 4: Initial Adjective Vocabulary
(Data Source: Collated by This Research)

Japan	Taiwan	Korea	China
Textured	Technological	Innovative	Digital
Functional	Fashionable	Thinness	Portable
Quick-adaptable	Tasteful	Compact	Top-level
Minimal	Simple	Fashion	Elaborate
Charming	Delicate	style	Trendsetting
Convenient	Durable	Colorful	Individual
Individual	Brand-new	Handy	Flimsy
Adorable	Popular	Particular	Fashionable
Frivolous	Spiffy	Function	Eye-catching
Epochal	Distinct	Smart	Noble
Progressive	Individual	High Tech	Intelligent
Original	Laconical	Curvaceous	Classic
Easy	Light	Smooth	Boutique
Secure	Lovable	Palmary	Reserved
Angry	Classic	Shine	Luxurious
Exquisite	Ultrathin	Cute	Elegant
Gorgeous	Senior	Charming	Cute
Expressive	Young	Sport	Alternative
Advanced	Commercial	Crazy	Dynamic
Lineal	Leisure	Magic	Cool

From Table 4, we can see that the adjective vocabulary of the same meaning varies slightly from each other in terms of the words used in different countries. From the preliminary view of adjective vocabularies that describing the functional level, "Technological" is used in Taiwan; "Digital" is used in China; "High Tech" is used in Korea; "Functional" is used in Japan. It will result in different usage of adjectives, and has a great relationship with its cultural background and language diction. From the perspective of Japan and Korea, The development of its product research and development is relatively faster than that of Taiwan and China, therefore, it belongs to new technology and new function at the functional level. In addition, China uses the meaning of "Digital + Technology" in its diction.

In addition, this study is used to test the adjective vocabulary of emotional preference, and the initial selection is good-looking and like. The difference between the two words is that the taste may feel that the product is "good-looking" but not necessarily "like" by the individual. Therefore, the final adjective vocabulary will be confirmed after the experts have discussed them.

It is important in design language that design of "spiritual domain" and "soft service" is based on such viewpoint and a correct sequence. The key to the application of design language is uniqueness, universality, truthfulness, consistency and specific fields. Conceptual design methods have such characteristics such as design, concept and business planning, which will become fixed methodology as well as the direction of joint efforts of a company's management, decision-makers and designers. After

all, there is a lot of gap between design language and the unpredictable market changes. Designers can shorten the gap through the expression of design language, which was difficult to be achieved by conceptual designers in the past.

In the 18th century, the German aesthetic scholars' proposition on the concept of aesthetic feeling was based on the aesthetic experience of the subject's perceptual capacity and they believed that aesthetic feeling was not only derived from the experience of daily life. The feeling and judgment of aesthetic feeling are also different from each other, and will be related to personal preferences, life fields, knowledge and so on.

On the whole, aesthetic response is a series of processes of accepting perception, conducting cognition, generating love and finally making preference judgments according to the observer's different personal attributes; aesthetic ability is influenced by everyone's living environment and various social factors, which results in everyone having different aesthetic experiences and preferences for the same thing. Further, it can be said that things with aesthetic appearance can satisfy people's basic needs, bring people a pleasant psychological condition, and also promote people's pleasure when using products.

In the book of Aesthetic Judgment Development Research, it is mentioned that there are four main principles for the selection principle of stimulants in the aesthetic judgment(Cui, 1992).

- Exemplary Principle: Aesthetic stimulants must be recognized as the most valuable model work so as to have the possibility to trigger the in-depth judgment.
- Principle of Cultural Differences: A complete theoretical framework of aesthetic development should cover cultural differences. When selecting aesthetic stimulants, the representative works of different cultural traditions should be included. (Table 5)
- Principle of Style Differences: Selecting aesthetics stimulants should include works of different styles, so as to observe whether the respondents have unbiased appreciation attitude.
- Principle of the Evolution of the Times: Selecting aesthetics stimulants should include the style developed by the evolution of the times.

Table 5: Adjective Vocabulary of Different Cultures
(Data Source: Collected by this research)

Culture	China	Japan	Korea
Common Adjective Vocabulary	Classical	Classical	클래식 Classical
	Style	Style	스타일 Style
	Individuality	Individuality	개성 Individuality
Adjective Vocabulary1 (Technical Level)	Technological	Textured	혁신 Innovative
Adjective Vocabulary2 (Emotional Level)	Tasteful	Charming	정취 Charming
Preference Vocabulary	Favorite	好きだ	좋아한다 Like

EXPLORATION OF NEW LANGUAGE FOR FUTURE PRODUCT DESIGN

The innovation language for product R&D includes visual form, man's behaviors, green design, etc. By analyzing the connotation of corporate culture, business strategy and design philosophy, manufacturing level, etc., various product symbols are encoded. Together with the forms, colors, texture, ergonomics and technological factors of products, we will express the functional elements of the products and illustrate the characteristics of products. For example, the visual form of products is a conveying medium loaded with information. The form factors of products endowed by the designer are an accumulation of experience of designers over the time, which show the basic nature of general design symbols. A good product image is established based on an intermingle between the form of the product and semantic symbols of functions to reflect the product spirit behind the material surface of visual forms. It is conveyed through the imagination of users in product psychology and satisfies the sub-consciousness of users in the interaction between man and products. While satisfying the demands of users, it can fulfill the emotional values of the product. Nowadays what is worth mentioning is environment protection, which has become one of the important design languages in the contemporary era. Green design is a design philosophy and method with an aim to save resources and protect the environment. There are also design language in other fields such as fashion style, national characteristics and traditional characteristics. Special cultural factors can also become an element of design language. Preciseness and safety will also be transformed into images and functions by the designers through the aforesaid semantic expressions. Meanwhile, designers will explore the potential of semantic symbols, blend the themes such as humanity,

technology and environment protection into the design semantics to convey the care of designers about the society and their pursuit of a bright future.

While designers are integrating the functional and aesthetic requirements of products, they also comprehend the design language and fully grasp the demand resources of future design. Through an investigation of perceptual image of products, they find out the preferences of customers in images. By adopting a model combining the depiction of connotation and extension, they will confirm the form characteristics of the product and apply statistical analysis to raise and discuss the concepts of product model and perceptual image, establish a matching model for perceptual image between users and designers and explore the key techniques and research methods. Finally, we will find out the correspondence between the perceptual image in the mind of customers and the product form Table 6. New values will be infused into products by blending man's perception into the product design to innovate the design language.

Table 6: Culture Traits and Symbolism of Artifacts Products
(Data Source: Chen Meicen, 1992)

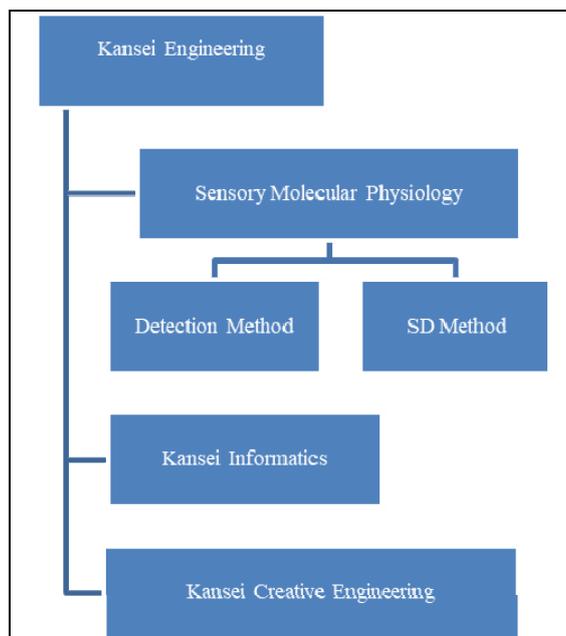
Type	Description
Shaping Traits	Nature shape, geometric form composition, borrowing modification form.
	Symbolization: Through the evolution of the times, the organic and geometric forms in shaping are often endowed with new meanings.
Material Traits	Local common product materials will be used in different materials according to regional differences.
	Symbolism: It likes the material of gold and represents the symbol of wealth; diamond is the symbol of nobility and magnificence.
Shape and Structure Traits	The use of utensils and changes in the concept of related things will change the shape and structure of the utensils.
	Symbolism: Shape and structure can reflect the social significance and philosophical thoughts at that time. The shape of inner circle and outer square alike represents the cosmology of ancient philosophy.
Colour Traits	The color habit of a region culture can be seen from its nationality. If the national character is full of ebullience, its product color is often bright and colorful; if the public emphasizes seriousness and precision, its product color tends to be conservative and pure.
	Symbolism: Different cultures have quite different views. Yellow, for example, represents dignity and elegance in the East and has a positive connotation; while in the West, it tends to have a negative connotation.
Structure Traits	In addition to function, the external structure of the objects is followed by the pursuit of aesthetics.
	Symbolism: The East and the West have different views on the structural proportion. The West pays more attention to the proportion of gold, while China also integrates the advantages of organic curve for the curve of artifacts in addition to reasonably calculating its proportion.
Life Behavior Traits	Life behavior becomes a unique culture through the accumulation of the time, and the image of its behavior and the utensils used will also become the representatives of culture.

By applying semantic differential and statistical methods in Kansei engineering, we will establish a scientific norm for product modeling based on the product images preferred by users, thus explicitly exploring the relationship between the product images preferred by users and product model, so as to facilitate the unfolding of design conception scheme (Figure 1). Meanwhile, under the precondition of guaranteeing product's functional demands, we will coordinate the internal mechanism and external image of products so that materialized technical design and artificial industrial design will be unified organically in product design. The product design thought which blends material functions of products into their overall model and image has facilitated the upgrade of product design concept and innovative design of products.

Nowadays the issues on innovation language at the following levels are to be studied by enterprises:

- (a) The concepts of new perception such as comprehensive values.
- (b) Improvement of the internet era and demands of customers.
- (c) The emerging of complex systems such as robots and universe fulfillment.
- (d) The necessity of effective design techniques in the era where there are a lot of cultural contents.

Considering that these are essential to the design of 21st century, we need new design directions. We will initiate new design directions based on the conceptual design and create new language leading design for designers.



Source: This study.

Figure 1: Schematic Diagram of Kansei Engineering Application.

CONCLUSIONS

The innovation language of future design is developed to adapt to the objective situation of rapid development of science and technology and address the challenges faced by the human society from economy, politics, culture and technology. Through far-sighted thinking, future design aims to lead the welfare of people today and future generations which have not yet come true. It can be said that innovation language of design is a series of unique methods. Through the methods and theories, the “design mechanism” will be unfolded. Therefore, the application of conceptual design language and theories is an important part of the overall theory development. The innovation language of conceptual design will lead the comprehensive and strategic design mechanisms.

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Health service support system for aging people in smart communities from the social support perspective

(Full Paper)

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ABSTRACT

Smart community provides opportunities to develop the elder care system with information technologies for elderly people. Most existing studies on elder care system are from the macro level and there lacks practical development in this area, especially has ignored diversified elderly people's health needs. This study tried to investigate the elderly people's health needs by conducting interviews in two smart communities (Sanli community and Tieli community in Hefei city, Anhui province). We have interviewed 16 older adults and 16 of their grown-up children in the communities. With the help of Nvivo12, health needs about elderly people are coded into 57 free nodes and 8 tree nodes elderly people, which are further divided into four aspects based on the social support angle, information needs, instrument needs, substance needs, and emotion needs. Finally, we developed the health service system of smart communities from the subjects and functions of social support perspective. Through this study, we can better understand health needs of older adults and provide references for the development of health services in smart communities.

Keywords: Older adults, smart communities, health needs, health services, social support.

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INTRODUCTION

With the rapid development of information technology, especially the development of internet technology, informatization levels in urban populations have seen a rapid progression. Countries and government organizations have been developing the policy plans and relevant blueprint, which lean heavily on information and internet technology to promote the rise of smart cities (Zheng *et al.*, 2013). Smart communities have been proposed (Wu, 2013) as an important part of smart cities, among which smart health care system plays an important role. More and more residents are inclined to seek daily medical needs from communities rather than from large hospitals (Wu, 2017). In the "13th five-year plan" for the development of China's undertakings for the older adults, it was proposed to build a comprehensive information network and service platform for eldercare in the community with the achievements of modern science and technology. The platform aims at generating convenient and efficient services for older adults living in the community, and actively promoting health services. Shared elder communities are the main place where old adults spend the final years of their lives. These shared communities provide housekeeping, business, and entertainment service. It is expected that health services gradually play a more central role in the community service with the general improvement of people's health consciousness.. For example, the community can provide disease prevention and control, primary diagnosis and treatment of common diseases, management and rehabilitation services for chronic diseases and so on. This trend can change health service models in the community and improve the level of service, gradually taking the responsibility of "gatekeeper" of residents' health (Zhao, 2014).

Presently many countries across the world are facing the issue of aging population. In China, "The 13th five-year plan for the development of undertakings for the older adults and the construction of the elder care system" predicts that the number of elderly people over 60 years older will increase to about 255 million, accounting for 17.8% of the total population by 2020. Elderly people living alone or without family support network will increase to about 118 million, and the old-age dependency ratio will increase to about 28 percent. For this reason, social security for the older adults continues to rise. China has the largest elderly population in the world, accounting for about one fifth of the world's elder population. The unique national conditions of "getting old before getting rich" makes the social problem of elder-care extremely urgent in the 21st century. China will face a period of severe aging and pension problems. Besides, due to their physical needs and vulnerability, adults have even more urgent needs for health care compared to other groups. For this reason, scholars have found that the development of health services for older adults is insufficient, and health needs of older adults are not satisfied (Wang, 2018; Ma & Zhou, 2018).

In practice, problems like tax regulation, unclear policies, single service content and lack of pertinence are prominent (Wu, 2017). In particular, the health services associated with older adults has a series of problems including uneven quality of

information, insufficient accuracy of data sources, unreasonable service and a lagging data update (Qian *et al.*, 2018). According to a report by Tencent entitled “big health industry data insight report” in 2019, the older adults are the main force within the health industry, and they are interested in obtaining health knowledge, exchanging health information, seeking health products and process of medical treatment, especially in sharing health information and product use (Tencent, 2019). The older adults have gradually become the focus of health care services. Existing research on older adults’ health service needs in smart communities is too general. The older adults’ health care needs are not clear, and the health services of smart communities lack theoretical guidance. This study aims at exploring old adults’ health needs through semi-structured interviews and constructing a health service system for smart communities. We expect to contribute to the personalized health management service, enrich the relevant theory of health services and promote the development of health service of smart communities in practice.

LITERATURE REVIEW

Health Needs

The existing research on health needs mainly focuses on the field of medical healthcare and information science. The former focuses on certain type of disease and specific user group, while the latter pays more attention to health information needs. For example, the health needs of patients with scoliosis are mainly mental and physical health needs (Xue, 2019). Pregnant women’s’ health needs in clinics of obstetrics and gynecology are related to nutrition, fetal education and analgesia (Xie & Liu, 2018). The health needs of college teachers are regular physical examination, health education methods, disease prevention, healthy life and healthy diet (Zhao *et al.*, 2012). The health needs of trafficked people are an individuals’ entitlement to healthcare, availability of healthcare resources, providers of key knowledge, and the unique demands of trafficked individuals (Williamson *et al.*, 2020). There is a difference in mental health needs of rural residents and their urban counterparts, mainly access in prescription medications (Kirby *et al.*, 2019). For health information needs, some scholars have found that breast cancer and diabetic patients are interested in topics such as nutrition, specific diseases, and fitness (Cleveland *et al.*, 2008). The health information needs of cancer patients undergoing chemotherapy mainly focus on disease treatment and symptom control (Youssef *et al.*, 2019). Pregnant women pay more attention to health information regarding the unborn child, nutrition and childbirth (Ghiasi, 2019). As for the health needs of the older adults, it is found health care and related diseases is the main content of health information queries (Hou & Sun, 2015). The health needs of the urban elderly are more likely to come from medical consumption, chronic disease care and medical insurance (Song & Liu, 2007). Abdi *et al.* (2019) believed that older adults face physical, social and psychological challenges and are in urgent need on information support in social activities, relationships and mental health. Palmer *et al.* (2014) found that older adults living in the community were paying close attention to bladder health, nocturia, drug safety, physical activity/exercise through a “health hydrate” project. It is found that the research on older adults’ health needs is not clear and the connotations are macro. Older adults’ health needs tend to be diversified with multi-level characteristics. For example, Stephen (2012) said that elderly care needs an all-round and multi-angle excavation.

Health Service

Western health services developed earlier than Chinese services. The health service practice and theoretical development are relatively mature, for instance, Britain's National Health Service has an established information service system to increase the system efficiency of health services. It also brings the health service competition at the community level, which aims to fundamentally protect the health of the residents, and make it easier to get satisfactory health service (Liu *et al.*, 2013). The community level health care services reduce hospital costs yet community users can make diagnoses of diseases according to relevant data and have timely feedback on a resident’s health status (Breslow *et al.*, 2004). Some communities construct health-monitoring systems that can integrate and share medical resources and health information (Stefanov *et al.*, 2004). There are also communities that build health management systems to guide community users by tele-therapy (A1-Attas *et al.*, 2012; Beul *et al.*, 2010). Chinese scholars started relatively late and mainly focus on the technology and countermeasures. Liu & Wu (2007) put forward technologies of using residential networks and built a health service system for primary care. Yan (2018) designed remote collection platforms for community health services by using Spring, Spring MVC & Mybatis (SSM), and achieve dynamic effect in JSP by Java Script+jQuery, through which doctors can diagnose remotely based on the physiological characteristics of users. At the same time, Zhang *et al.* (2013) proposed the “hospital & community & family” health service model for chronic diseases, by which patients can share health information, make full use of medical resources and establish close doctor-patient relationship. Yue & Li (2014) proposed that community health services should be given high priority in the social system, so that social organizations can take full role in the process and the health consciousness of community users can be enhanced. Concerning research on health services for the older adults, Niwa & Nishi (2017) suggested the information platform for smart communities should pay more an attention to the acquisition and sharing of data for older adults. Hamada *et al.* (2019) used people aged 75 years or older in Japan as samples and concluded that consultations with physicians and an increased use of inpatient services are key factors. Buchner *et al.* (1997) found older adults living in a community are concerned with health services regarding short-term exercise map, gait, balance, and physical health status. However, in the research on China's national conditions, especially the smart communities, this new pension mode is rarely found.

Social Support

As a classical sociology theory, social support theory has been playing a central role. Previous studies have different

classification scheme on social support. Wineman (1990) proposed social support includes emotional support, financial support and companionship while Cutrona (1989) thought social support includes instrumental and emotional support. Riffle *et al.* (1989) divided social support into emotional support, social integration, network support, self-esteem support, material support and information support. Overall, it can be said that social support is divided into subjective support and objective support. Subjective support includes emotional support, while objective support includes material support, information support, economic support and so on. In recent years, social support theory has been applied to the field of the aging care in explaining aging behavior. Li (2019) further divided the functions of social support for older adults into basic life support, emotional support, social relationship support, and security support, and the main object of social support included community workers, pension service institutions, and volunteer groups. Fang (2013) believed that social support for older adults who have not had offspring should come from the government, communities, social organizations and the elderly themselves, and communities should care about the differences in gender, education level, income, social policies and other factors. Kempen *et al.* (2012) found that the impaired vision of older adults in community-living demands more social support, especially professionals' nurses providing quality care. It can be found that social support theory may guide the development of elderly care services.

In general, the research on the health service system of smart communities for older adults was not systematic and in-depth, especially the health needs of older adults, which are not thorough and multivariate. Health service systems in smart communities lack the guidance of relevant theories. So we try to explore health needs of older adults and build the related health service system from the perspective of social support.

METHODOLOGY

Research Method

We have conducted a semi-structured interview based on the grounded theory method. The ground theory approach is a qualitative research method generally accepted in practice (Strauss & Corbin, 1990). It is more applicable to the explorative research that aims to develop theories. Theories are generated through interview analysis. There are three steps for ground theory approach: open coding, axial coding, and selective coding.

Research Object

This study selected two representative smart communities: Anhui province (Sanli community and Tieli community in Hefei city). The world health organization (WHO) defines those as above 60 years of age in developing countries as older adults, so the average aged person in this study is over 60 years old. In order to interview efficiently, we selected the older adults who can communicate clearly. In order to better understand older adults' health needs, we also interviewed their children. Finally, 16 older adults and 16 grown-up children agreed to participate in the study. The demographic information is shown in Table 1.

Table 1: Demographic information.

	Category	Count	Category	Count
	Older adults		Their children	
Gender	Male	10	Male	9
	Female	6	Female	7
Age	60-65	8	20-30	3
	65-70	6	30-40	6
	>70	2	>40	7
Education	Unschooling	2	unschooling	0
	Private schools / primary schools	6	Private schools / primary schools	4
	Junior high school	5	Junior high school	6
	High school/ technical secondary school	2	High school/ technical secondary school	3
	University (including junior college) or above	1	University(including junior college) or above	3

Research Procedure

In the early stage of this study, the recruitment was conducted mainly through the cooperation with the community. We posted posters to introduce the purpose of the study, the conditions of the objects, the time required for the interview and the remuneration. The final interview time was determined to be from 1/5/2019-3/5/2019, during the May Day holiday, so the available time of users was relatively abundant. Before the interview, we coded 16 old people as A1, A2... A16 and 16

grown-up children as B1, B2... B16. The interview process was divided into two groups, which of one group interviewed the older adults and which of the other group interviewed their grown-up children. Each group was composed of two researchers, which of one of responsible is to ask questions and the other for records. The interview is conducted in a face-to-face manner. Before the formal interview, it is necessary to explain the purpose of the interview to the interviewees, tell them that the whole process needs to be taped for later data analyzing, and promise that the recorded content will only be used for academic research and no personal information will be disclosed. At the same time, researchers should pay special attention to the emotional state of the older adults, and timely adjust the interview structure and content, so as to facilitate the interviewees to fully express their views. The whole interview follows the logical progressive and divergent thinking mode. We mainly ask about health needs, difficulties, benefits, suggestions etc.. The questions are: ① what health needs do you/your parents have? ② Do you/your parents have any other health needs? Can you say more? ③ What is your current community like, and do you/your parents have any difficulties? ④ What health services does your community provide for you/your parents? Detailed questions are shown in Table 2.

Table 2 : Interview questions.

#	Question to older adults	Question to their children
1	What health needs do you have?	What health needs do your parents have?
2	Do you have any other health needs? Can you say more?	Do your parents have any other health needs? Can you say more?
3	What is your current community like and do you have any difficulties?	What do you think of your current community and do your parents have any difficulties?
4	What health services does your community provide for you?	What health services does your community provide for your parents?
5	Do you think the health services in your community have helped your health?	Do you think the health services in your community have helped your parents' health?
6	Do you have any other health needs that are not being met? What is that?	Do your parents have other health needs that are not being met? What is that?
7	Please provide suggestions about health services in your community.	Please provide suggestions about your parents' health services in your community.

DATA ANALYSIS AND RESULTS

After the interview, the researchers need to translate the recording into text, in which of older adults were encoded as X1, X2,... , X16 and their children are encoded as Y1, Y2... Y16. The entire coding process is handled in Nvivo11, which are powerful and flexible qualitative analysis software developed by QSR (Qualitative solutions & research) in Australia. This software is specially designed for large-scale qualitative research projects, with convenient data input and output, which provides 8 main functions: internal, node, set, queries, models, links, classifications, folders, so that the process of qualitative research and analysis is speed up (Bauer & Gaskell, 2000; Norman et al., 2006). The whole process of this study was conducted by browsing and coding at the same time. The specific details are as follows:

Open Coding

In this process, 32 transcribed texts needed to be encoded, three of which are randomly reserved for a saturation test. It should be noted here that in order to better reflect the real health needs, the encoded nodes must ensure their primitiveness as much as possible. For example, a participant whose code number is A6 said that “I have diabetes, so I like watching health shows on TV around a sensible diet, exercise and the different types of diabetes”. We will code (select) key phrases Diet, exercise, types of diabetes. The other participant coded for A13 said that “my children bought me some instruments which can test my blood pressure, blood sugar and so on, but I always forgot how to use and must seek help from my children every time. Especially, when each test finished, it will generate a lot of data which is hard to understand. I can't determine if my blood pressure or blood sugar is high or low, I really wish there was some training”. We will encode the usage of the instrument, the interpretation of the health data and training. Finally, we coded out 137 free nodes, and the operation process in Nvivo12 is shown in Figure 1:

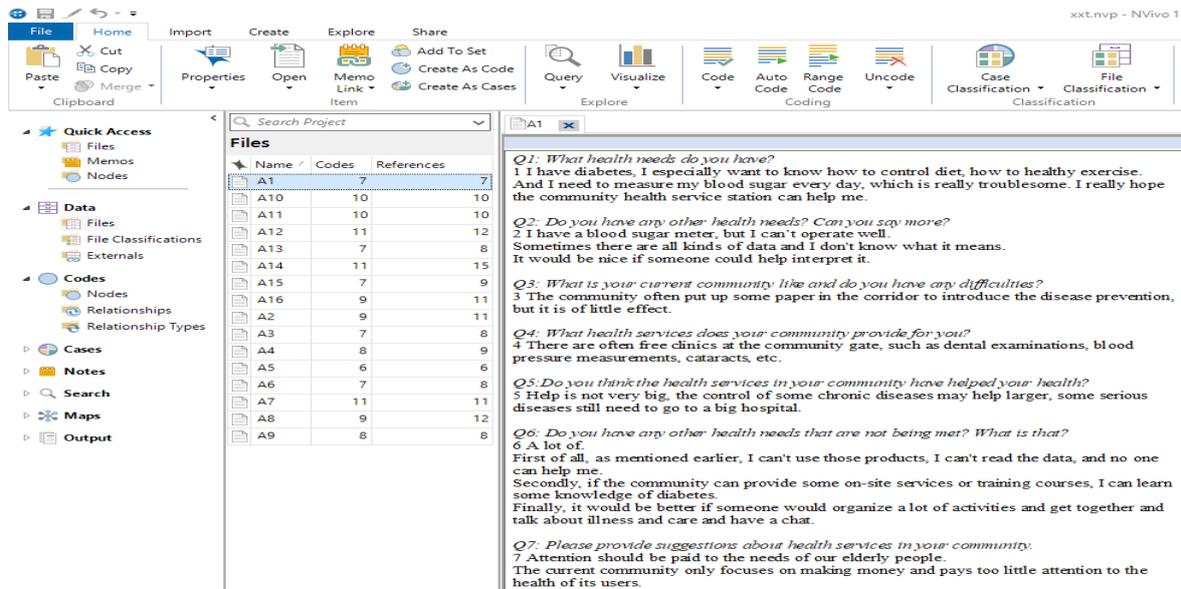


Figure 1: The process of open coding.

Axial Coding

Axial Coding is to sort out the free nodes obtained in the open Coding process, then merge the nodes with repetition and similar meanings, and further summarize them into higher level tree nodes. For example, treatment and seeing doctors is a similar concept, collectively referred to as treatment. Use and operation are also a similar concept, therefore are unified to the use.

Exercise, diet, sleep, longevity are the nodes mainly involved in daily healthy life. We put them into one category and named them as daily health. Similarly, diagnosis method, diagnosis result, prescription, treatment plan, medical record are the nodes mainly involved in the diagnosis and treatment process related to the disease. We put them in one category and named diagnosis and treatment. However, from Open Coding process, we found that the health needs of the older adults were relatively scattered, with 69 nodes with a frequency of 3 or below. In order to highlight the main health needs of older adults, the nodes with a frequency above 3 were selected for analysis in this study. Finally, after repeated induction and discussion, the research team finally obtained 57 free nodes and 8 tree nodes. At the same time, after the saturation test, we found that the internal consistency of the code reached 90.07%, which met the research requirements, and allowed for the continuation to the next operation.

Selective Coding

In this process, we need further summaries the free nodes and tree nodes to find the hierarchical relationship, parallel relationship or causal relationship. Through analysis, we consider that there is a parallel relationship between different tree nodes. Based on existing research on the classification of social support (Wineman, 1990; Cutrona, 1989; Riffle *et al.*, 1989), and combining with results in axial coding, finally, the 8 tree nodes were divided into 4 higher levels: information needs, instrument needs, substance needs, emotion needs. Information needs contain daily health, pathological knowledge, diagnosis and treatment. Instrument needs contain the use, booking, pay, etc. related to wearables devices and mobile terminals. Substance needs contain purchase, reimbursement ratio, nursing home fees, home care fees and so on related to medical insurance and medical cost. Emotion needs are related to mental health that involved patient support, help, loneliness, depression, etc., the specific whole node is shown in Table 3.

Table3: Health Needs.

Tree Nodes	Tree Nodes	Free Nodes
Information	Daily Health	Diet, exercise, health maintenance, sleep, nutrition, longevity, health care, lectures, popular science, physical examination
	Pathological Knowledge	Types of disease, pathologic etiology, symptoms, complications, preventive care, rescue measures, precautions
	Diagnosis and Treatment	Diagnosis method, diagnosis result, prescription, treatment plan, medical record, medicine, prognosis
Instrument	Wearables Devices	Usage, data interpretation, function, effect, product category, health privacy, experience, health certification
	Mobile Terminals	Register/login, book, pay, search, notify, comment
Substance	Medical Insurance	Payment/purchase, insurance rules, insurance coverage, reimbursement ratio

	Medical Cost	Nursing home fees, home care fees, household service fees, drug fees, hospital fees, treatment fees, examination fees, education fees for the elderly
Emotion	Mental Health	Disease communication, patient support, help, understanding and tolerance, inferiority, loneliness, depression

DISCUSSION

After the three coding stages - open coding, axial coding, and selective coding, we identified 57 free nodes, 8 tree nodes, and corresponding 4 core tree nodes. Next, we will build the service system from the perspective of subjects and functions of social support. The subjects of social support involved in this study are government departments, enterprises, medical service institutions, smart communities, volunteers and so on. The main functions are as follows: information support, instrument support, substance support, emotion support, as shown in Figure 2.

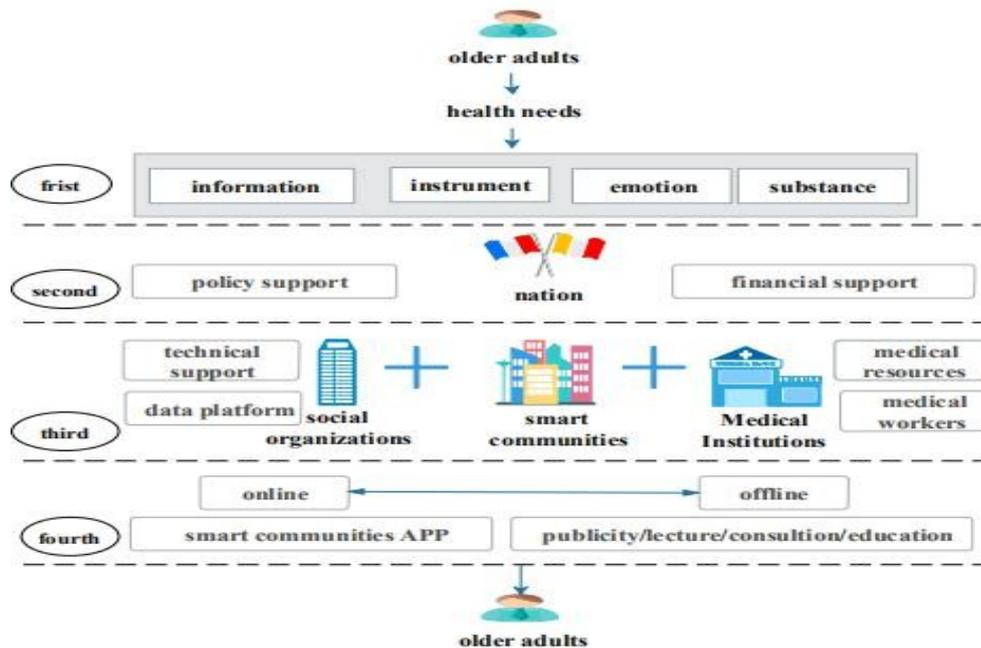


Figure2: Health service system.

The first layer refers to health needs of older adults. It belongs to the basic level and is the driver of health services in smart communities. According to the results of the interview, the health needs of older adults are divided into information needs, instrument needs, substance needs and emotional needs. But there are also variations within the health needs of older adults, for example, an interviewee coded A3 said that “I pay special attention to healthy diets.” Some books and fitness TV programs that often discuss food safety and how to match dishes are very helpful to me.” Another interviewee coded A9 said: “I don't pay special attention to healthy diets, nor do I limit my diet too much, I think too much attention will lead to the lack of nutrition in the body, as long as it is not too much.” So smart communities also need to pay attention to the characteristics of the older adults and provide targeted health services.

The second layer is about policies and regulations. As a decision-maker, the nation provides policy and financial support for the health services of older adults in smart communities, providing substance support in terms of medical insurance and medical cost. The optimal outcome is that the government should increase the policy support in the provision of care for the aged, intensify top-level design and overall planning for the older adults in smart communities, and establish a data standard system. In addition, current governmental departments should gradually increase the investment in the construction of health service platforms of smart communities, especially the support for the key technology. The nation should also increase financial support for health services of older adults. For example, the financial subsidy and reimbursement amount of medical expenses for older adults with major diseases or chronic diseases should be gradually increased, so as to relieve the financial pressure of such families in terms of health services and care services to a certain extent.

The third layer is about resources and cooperation. Smart communities need to cooperate with other organizations, such as medical institutions, social organization. Medical organizations such as hospitals, private clinics and community health service stations should provide education, training, health lectures, free diagnosis, tele-medicine, psychological counseling, door-to-door services, etc. Then help to realize the daily health, treatment, monitoring and distress measures of other multi-dimensional health service. Social organizations include the internet companies, electronic manufacturing enterprises, volunteers, elderly organizations and housekeeping organizations. Internet companies and electronic manufacturing

enterprises can provide instrument support for the development of health services in smart communities. Enterprise developers should regularly provide experiential teaching on the use of wearable devices and mobile terminal products and train the older adults on the use of electronic products. Volunteers, elderly institutions and housekeeping organizations should take a unified approach to smart communities to form a united service system, the old people can seek for help by urgent button, then related organizations can obtain effectively key information at the fastest speed, so as to provide information and emotion support. So this layer can provide information, instrument and emotion support.

The fourth layer is about service form/type. The key type is a combination of online & offline health services, online mainly through smart community APPs, The older adults can not only input, collect, query and analyze the health data, but also have various functions such as registration, medical treatment, housekeeping, first aid and user communication. For offline, the community should build a health service site where the older adults can consult and learn by themselves. At the same time, the community should provide information support, for example, regularly carry out daily health consultation, health lectures, as well as the publicity, education and learning education of common diseases. Then encourage more volunteers to participate in elderly care services, they can organize regular visits and one-to-one health reviews that can imply various functions of social support. This layer can also provide information, instrument and emotional support.

CONCLUSION

Based on the health needs of older adults, this study conducted interviews with 16 older adults and 16 of their grown-up children in two representative smart communities. We identified 57 free nodes, 8 tree nodes by open coding, axial coding, further combination with the classification of social support, the health needs of the older adults were divided into 4 core tree nodes. Finally, from the perspective of subjects and functions of social support, it further constructs the health service system of smart communities. In summary, this study can help us to enrich the research of the health needs and health services of the older adults in smart communities, therefore raising health consciousness of the older adults and guiding development of smart community health information services. At the same time, this study also has several constraints. In this study, the elderly participants are independent and can take care of themselves, whilst there is a population of individuals who are disabled and totally dependent on other, this population's health information needs should also be explored. Besides, we only collected data from two smart communities, so need to expand the number of participants. Finally, the health information service system needs to be tested in practice.

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Research on Influencing Factors of Information Dissemination of WeChat Public Accounts Based on FSIPS Two-stage Model

(Full Paper)

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ABSTRACT

The popularity and application of social media have a profound impact on user information dissemination in the Internet era. In China, WeChat's operation will face greater challenges as the number of Official Accounts climbs. This study focuses on the key factors of information dissemination effect in the two stage of "Sympathy under Feedback-Identify" and "Participate-Share & Spread" through constructing FSIPS two stage model, and analyzes the influencing factors of reading rate, comment rate and share rate from two dimensions in order to improve the distribution rate and information transmission for public operators.

Keywords: FSIPS two-stage model, WeChat official accounts, information dissemination.

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INTRODUCTION

In 2011, Tencent officially released WeChat, a new generation of communication social service software based on mobile Internet. As of the end of 2018, WeChat's daily login users have reached 1.025 billion. In July 2012, WeChat officially launched the Official Accounts function, linking users with information and services in the form of subscription number, enterprise number and service number, and became an important function layout of WeChat in the new media field. As of the first quarter of 2019, the number of WeChat Official Accounts that kept the publication reached 1.756 million.

However, with the increase in the number of WeChat Official Accounts, the operation and management of the WeChat Official Accounts is facing greater challenges. According to Penguin Intelligence's "2017 WeChat User & Ecology Research Report" released in April 2017, the new challenge of WeChat Official Accounts operation is the difficulty of traffic acquisition, the low viscosity of followers, the increase of homogenization content and the reading volume is slower than that of its fans. In 2016, the number of fans of the Official Accounts was mostly below 100,000, and the number of heavyweight public numbers reaching a million fans was only 1.8%. The improvement of content distribution conversion rate and information transmission efficiency has become the top priority for many WeChat Official Accounts to develop into heavyweight accounts.

For the information dissemination research of WeChat Official Accounts, most scholars use observation method and questionnaire survey method. At present, the WeChat Official Accounts has gradually changed from single content distribution to commercialization and specialization mode, and a large number of third party operators have come into being. These third party operators record daily users' concerns and articles' push data for WeChat Official Accounts. Centralized storage management of backstage data provides reliable data resources for academic research and analysis of information dissemination mode and user behavior. The systematic research in the academic circles will also lay a solid theoretical foundation for the operators of small and medium-sized Official Accounts to find out key operational indicators, enhance the activity and retention rate of old customers, and stimulate the growth of new users' attention.

Based on the user behavior model of SIPS social media and combined with the information transmission path of WeChat Official Accounts, this study divided the spread process into two stages, namely, "Sympathy under Feedback-Identify" and "Partition-Share & Spread", so as to establish the FSIPS model for the social media of WeChat Official Accounts. Based on the actual operational data of nearly 20 public numbers provided by Beijing Sootoo Company from September 1, 2018 to November 30, 2018, the appropriate operational data indicators are selected to represent the influencing factors and effects of the spread, through the data preprocessing, TFIDF text classification model, negative binomial regression model and other technical means to complete the analysis of the factors affecting the two-stage information transmission of WeChat Official Accounts, and finally identify the key influencing factors of information dissemination.

LITERATURE REVIEW

At home and abroad, the research on social network information dissemination is mainly based on the theory of information dissemination diffusion and the theory of knowledge dissemination and sharing. Lasswell (1948) first proposed the five elements of information communication, now known as the Lasswell 5W model, which successively corresponds to the five elements of people, content, channel, receiver and communication channel. Williamson (2011) proposed that communication influence is communication ability and its influence. Ni Yannian (2002) divided the knowledge communication into seven parts: the initiative, the receiver, the information, the specific behavior, the environment, the purpose and the final effect. Li Gang et al. (2013) elaborated the influence of network structure, network connection and social capital on knowledge sharing behavior, and summarized the guarantee and incentive mechanism of knowledge sharing. Using the theory of system dynamics and simulation experiments, Fumito comprehensively studied the factors affecting the five stages of information diffusion, and put forward relevant supporting suggestions in combination with enterprise practice.

Foreign researches on the mechanism of information dissemination and diffusion in new media social platforms mainly focus on Twitter and Facebook. Based on Twitter data, foreign scholars have provided valuable research conclusions for finding the most influential users in social platforms. The research found that the forwarding and sharing performance of star users' tweets is not necessarily the best. On the other hand, it verified that the influence of social platform users is not only related to the number of fans. Webberley et al. (2011) studied the main influencing factors of the depth and breadth of Twitter information dissemination. Yang et al. (2010) found that the content of information and the mentioning rate of related users are the key factors affecting information dissemination. In the Facebook platform, content vividness will have an impact on likes and comments. Facebook users are active for a period of time, which has a certain impact on the effect of information dissemination.

DATA PTOCESSING AND VARIABLE SETTING

This study selected 21 WeChat Official Accounts operated and managed by Beijing Sootoo company, involving three Official Accounts of life, entertainment and information, including 8 Official Accounts of life, 4 Official Accounts of entertainment and 9 Official Accounts of information. Data of 3,286 articles from September 1, 2018 to November 30, 2018 were collected, and 2,969 articles were retained after outliers were removed, re-nulling and pre-screening.

wx_username	nick_name	date	cancel_user	cumulate_user	netgain_user	new_user
gh_6233c5fc6563	电影天堂	2018-09-01	2,258	1,210,415	443	2,701
gh_b17fc7aa8475	电影院线	2018-09-01	141	174,673	-97	44
gh_d42545ef1b06	娱乐大爆炸	2018-09-01	167	426,698	-80	87
gh_efebbbad745c	电商头条	2018-09-01	6	120,277	-6	-
gh_29287a615e2c	思想新知	2018-09-01	91	405,858	-44	47
gh_c7b95d9e1a8b	大数据参考	2018-09-01	4	76,095	-2	2
gh_e1c3a1d33b1a	财经文摘	2018-09-01	9	122,916	-4	5
gh_5c0e09d45255	创业咖	2018-09-01	91	384,415	-45	46
gh_f0692ac72534	猫来了	2018-09-01	273	531,963	-122	151
gh_5755ad0bef67	微电影	2018-09-01	143	262,714	-36	107
gh_d9d4cb3ef81a	爱时尚	2018-09-01	44	228,301	-35	9

Figure 1: Changes in the Subscribed Users Number of the WeChat Official Accounts

wx_username	nick_name	date	time	title	is_first	msgid	like_num	read_num	comment_num
gh_f0692ac72534	猫来了	2018/9/1	2018/9/1 16:52	抖音上点赞78w的猫,前半生	1	2651006209_1	952	40542	131
gh_f0692ac72534	猫来了	2018/9/1	2018/9/1 16:52	如果这只猫成了你们公司的老	0	2651006209_2	388	11909	17
gh_f0692ac72534	猫来了	2018/9/1	2018/9/1 16:52	我竟然被这些彩虹猫给撩到	0	2651006209_3	1226	13473	16
gh_f0692ac72534	猫来了	2018/9/1	2018/9/1 16:52	每一只公猫的丁丁,都能cosp	0	2651006209_4	510	14482	29
gh_f0692ac72534	猫来了	2018/9/1	2018/9/1 16:52	一只橘猫为了吃的可以多拼命	0	2651006209_5	648	13093	27
gh_4672c12554c6	教育百科	2018/9/1	2018/9/1 18:29	西湖大学开学了!校长施一公	1	2651730759_1	2	443	1
gh_4672c12554c6	教育百科	2018/9/1	2018/9/1 18:29	剧透!《开学第一课》节目单	0	2651730759_2	2	942	1
gh_1dd9f2806c79	人力资源管理	2018/9/1	2018/9/1 18:30	老板若这么待员工,公司高才	1	2665528551_1	35	29990	16
gh_1dd9f2806c79	人力资源管理	2018/9/1	2018/9/1 18:30	面试了十几个HR主管都不达标	0	2665528551_2	13	4794	2
gh_1dd9f2806c79	人力资源管理	2018/9/1	2018/9/1 18:30	在这个职位上,你还能坚持多	0	2665528551_3	1	3168	0
gh_1dd9f2806c79	人力资源管理	2018/9/1	2018/9/1 18:30	我采访了1000个90后,终于知	0	2665528551_4	20	4706	7
gh_723dea9d08d4	最美旅行	2018/9/1	2018/9/1 18:31	100多年前遗落在人间的拉萨	1	2692398433_1	3	1080	0
gh_723dea9d08d4	最美旅行	2018/9/1	2018/9/1 18:31	看到这种鱼立刻逃跑!两天内	0	2692398433_2	2	942	0
gh_6233c5fc6563	电影天堂	2018/9/1	2018/9/1 19:30	9月烂片太多,只有这些能看	1	2662185935_1	200	75924	144

Figure 2: Article Data Sample

The Jieba word segmentation algorithm uses the prefix dictionary in the data structure to scan and classify Chinese characters, with high efficiency and precision. The Jieba algorithm has three modes: search engine mode, precise mode, and full mode. In order to analyze and segment the text as accurately as possible, the study selected the precise mode. We can quickly calculate the TF-IDF weights of different word segments by using the Count Vectorizer and TF-IDF Transformer classes in the Scikit-Learn package, thereby extracting the article content keywords whose TF-IDF weights are located in the top ten, and outputting the results to the specified Excel file as required. The specific code and calculation results are shown in the figure below.

```

29 vectorizer = CountVectorizer()
30 word_frequence = vectorizer.fit_transform(wordslist)
31 words = vectorizer.get_feature_names()
32
33 transformer = TfidfTransformer()
34 tfidf = transformer.fit_transform(word_frequence)
35 weight = tfidf.toarray()
36
37 n = 10 #前10位
38 for (id, title, w) in zip(ID_list, titlelist, weight):
39     print(u'{}:{}'.format(id, title))
40     loc = np.argsort(-w)
41     for i in range(n):
42         print(u'{}:{}'.format(str(i + 1), words[loc[i]]), end=';')
43     print('\n')
44
45 index=1
46 with open("D:\\TFIDF\\keyword_content.csv", "w", encoding='utf-8', newline='') as datacsv:
47     csvwriter = csv.writer(datacsv, dialect="excel")
48     csvwriter.writerow(["index", "msgid", "title", "key_1", "key_2", "key_3", "key_4", "key_5", "key_6", \
49         "key_7", "key_8", "key_9", "key_10"])
50     for (id, title, w) in zip(ID_list, titlelist, weight):
51         loc = np.argsort(-w)
52         csvwriter.writerow([index, id, title, words[loc[0]], words[loc[1]], words[loc[2]], words[loc[3]], words[loc[4]], \
53             words[loc[5]], words[loc[6]], words[loc[7]], words[loc[8]], words[loc[9]])
54         print(index)
55         index = index + 1

```

Figure 3: Calculation Process of TF-IDF Algorithm

msgid	title	key_1	key_2	key_3	key_4	key_5	key_6	key_7	key_8	key_9	key_10
2649728371_1	一支卓尔念师恩，广袤寰宇纳字间！	卓尔	特别版	书写	派克	寰宇	遨游	钢笔	老师	笔帽	灵感
2649728375_2	岛国电视台用动画还原犯罪现场，全程十分	岛国	沙雕	动画	现场	精心制作	清奇	视频	关注	电视台	跟线
2650422991_2	便秘的开关，竟然在手上，打开它，便秘口	便秘	支沟	按摩	李智	润肠	效果	健康	一穴	麻仁	王鸿谟
2650422991_3	秋冬必备“保暖指南”，给你一个开挂的冬天	保暖	兰尔迷	背心	短绒	内衣	肌肤	胸部	羊胎	面料	热量
2650422997_1	老年痴呆很可怕，预防原来这么简单，可惜	踮脚	老年痴呆	小脑	反射	血糖	脚趾	痴呆	肌肉	勾脚	中风
2650422997_3	冬天吃豆腐，好处太多了，50种豆腐做法，	豆腐	放入	胡椒粉	材料	做法	少许	倒入	料酒	适量	生抽
2650422997_4	长期吸烟咳咳咳！每天喝杯它，润肺止咳，	罗汉果	烟毒	嗓子	止咳	青果	二手烟	饮用	咽喉	花茶	肺部
2650423004_2	女人常戴银手镯，竟然会这样！越早知道越	健康	传递	健康长寿	长寿	百科	时尚	家人	温暖	记得	朋友
2650423004_3	比棉花糖还软的拖鞋，暖意从脚底直达心房	糖上	家居	棉花	伊藤	立减	日式	拖鞋	市场价	柔软	抢购
2650423012_2	它是天然防栓补肾药！比阿司匹林、六味地	核桃	核桃仁	黑芝麻	补肾	天然	阿司匹林	动脉	山楂	一氧化氮	六味地黄
2650423012_3	这样的保鲜膜有毒，每个人都要知道！	保鲜膜	保鲜	器皿	pvc	硅胶	微波炉	食物	奶嘴	串味	烦恼
2650423022_1	每天吃个它,胜吃10个苹果!降血脂,降血压,控	土豆	抗性	淀粉	放入	降血脂	降血压	土豆丝	含量	去皮	血糖
2650423022_2	这样搓脚，最补肾，记住里面的三个字！	健康	传递	健康长寿	长寿	百科	时尚	家人	温暖	记得	朋友
2650423022_3	手指出现这种隆起，是肺癌的预兆，一定要	扶指	肺癌	手指	李先生	缺氧	症状	末端	体征	征兆	名词
2650423022_4	再也不怕衣服粘毛了！简单一招，毛发杂物	xa0	粘毛	毛刷	静电	小号	两组	买大号	除尘	粘毛器	毛发
2650423047_1	脖子上出现这3种东西，说明癌细胞已经醒	脖子	癌症	发黑	颈部	淋巴结	肿块	饮食	标志	饮酒	过量
2650423047_2	今天才知道，煤气灶上一根牙签，一年能	健康	传递	健康长寿	长寿	百科	时尚	家人	温暖	记得	朋友
2650423047_3	什么叫养生？	气血	养生	经管	五脏	经络	理由	推荐	人体	营销	脏腑

Figure 4: Samples of Keyword Extraction Result

This study comprehensively considered the non-linear and multi-point information transmission scene and characteristics of Official Accounts as a new media social platform, and modified the existing SIPS model to form a two-stage FSIPS model (as shown in figure 5). The dissemination of articles on the Official Accounts is characterized as two stages of "Sympathy under Feedback- Identify" and "Partition-Share & Spread".

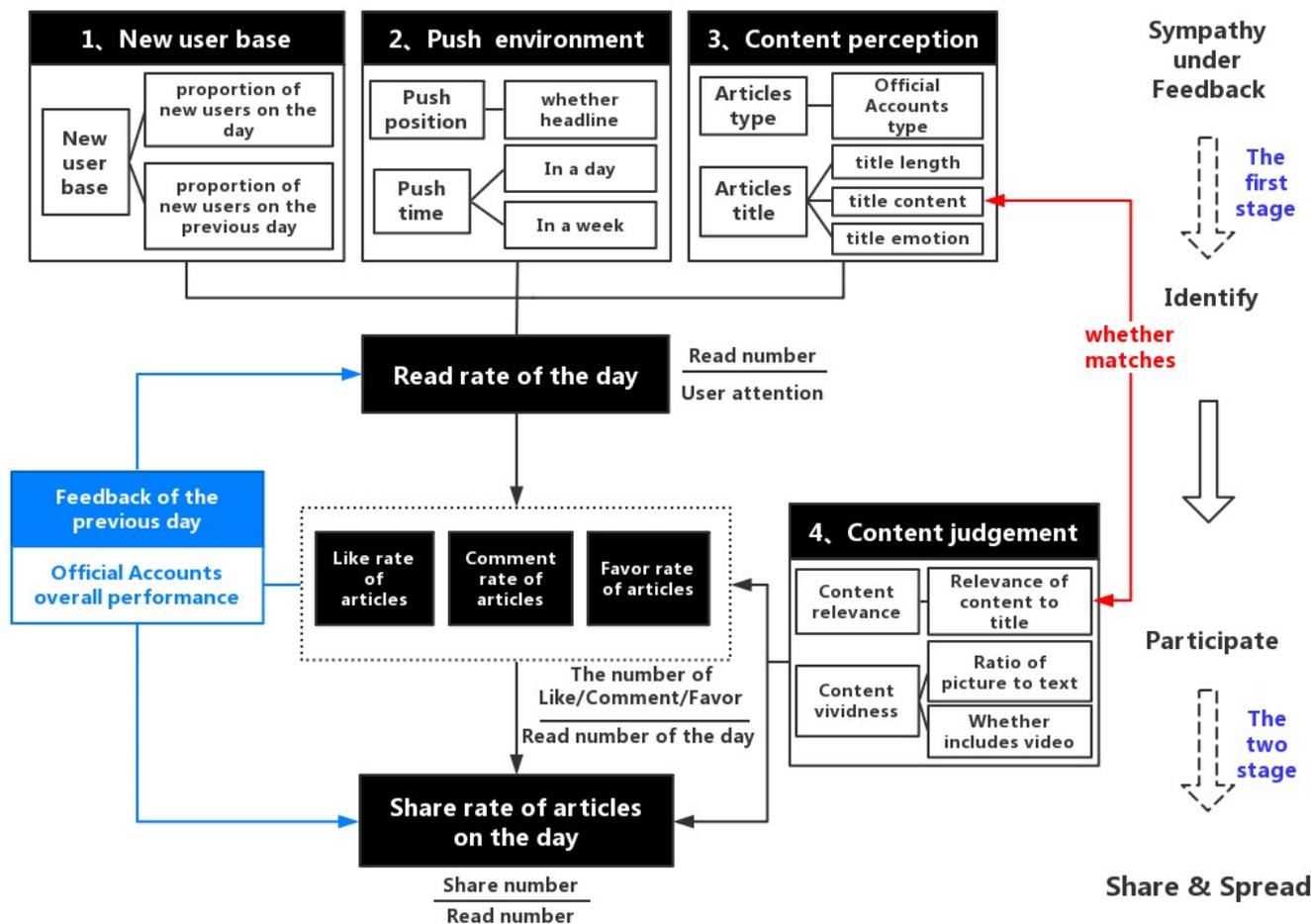


Figure 5 : Basic Schematic Diagram of Two-stage FSIPS Model

The first stage research model takes the click-reading rate of the article as the research object, Number of subscribed users of the day as the exposure variable, and we select the potential influencing factors as the independent variables in the four dimensions of new users, push environment, external content perception and feedback influence, set the reading number as a dependent variable, and further focus on the behavior conversion mechanism of WeChat users "focus-click-read".

In the second stage, we take the views of articles as the exposure variable, the favor rate, comment rate and share rate of article, as well as the internal characteristics of content (content vividness, content relevance) as independent variables, the number of article share as dependent variable, to test their impact on the users "Shared diffusion" stage.

The definitions of dependent and exposed variables are shown in table 1, and the independent variables are shown in table 2.

Table 1: Dependent and Exposed Variable Definitions

Variable definitions	Stage	Independent variables	Variables identify
Dependent variable	The first stage The two stage	Read number of the day Share number of the read	$read_num(i,j,t)$ $share_num(i,j,t)$
Exposure variable	The first stage The two stage	Official Accounts' cumulate user of the day Official Accounts' read number of the day	$cumulate_user(i,t)$ $read_num(i,j,t)$

Table 2: Independent Variable Definition

Stage	Dimension	Independent variables	Variables identify
The first stage	New user base	The proportion of new users on the day	$ratio_newuser(i,t)$
		The proportion of new users on the previous day	$ratio_newuser_t1(i,t-1)$
	Push environment	Push time whether weekend	$is_weekend(i,j,t)$
		Whether lunch break Whether time from work	$is_noonbreak(i,j,t)$ $is_quitting(i,j,t)$

	Whether before bedtime	is_bedtime (i, j, t)
	Push position whether headline	is_first (i, j, t)
Content perception	Official Accounts type	account_type (i)
	Whether title length not more than 15 words	is_notmorethan15 (i, j, t)
	Whether title contains emotional punctuation	is_emotional (i, j, t)
Feedback influence	Comment rate of the previous day	ratio_comment_t1 (i, t-1)
	Like rate of the previous day	ratio_like_t1 (i, t-1)
	Favor rate of the previous day	ratio_favor_t1 (i, t-1)
	Share rate of the previous day	ratio_share_t1 (i, t-1)
Action participation	Comment rate of the day	ratio_comment (i, j, t)
	Like rate of the day	ratio_like (i, j, t)
	Favor rate of the day	ratio_favor (i, j, t)
The two stage Content judgement	Official Accounts type	account_type (i)
	Picture text ratio	conlen_img (i, j, t)
	Whether contains video	is_includevideo (i, j, t)
	Content middle matches title	middle_relevance (i, j, t)
	Content high matches title	high_relevance (i, j, t)

MODEL CONSTRUCTING

“Sympathy under Feedback- Identify” Model

Firstly, this chapter uses the negative binomial regression model to describe the distribution of the number of times that WeChat users click to read an article per unit time. Taking the reading amount of the article in the j th article published by WeChat Official Account i on the t -day as an example, the reading amount in the day is recorded as $read_num(i, j, t)$. The observation time is divided into infinite average segments, which approximately gives each concerned user a period of time to decide whether to read or not. The click-and-read behavior of concerned users in different periods of time is mutually independent. Then the average reading amount per unit time is $read_num(i, j, t) / cumulate_user(i, t)$, that is, the reading rate of articles is $read_ratio(i, j, t)$, which obeys the negative binomial distribution. The main factors affecting the click reading rate can be studied by establishing a negative binomial regression equation.

We introduce the independent and dependent variables in the first stage of FSIPS "Sympathy under Feedback-Identify" into the negative binomial regression equation, and construct the research model as follows (1):

$$\begin{aligned}
 \log[read_ratio(i, j, t)] &= \log\left[\frac{read_num(i, j, t)}{cumulate_user(i, j, t)}\right] \\
 &= \alpha_0 + \alpha_1 \times ratio_newuser(i, t) + \alpha_2 \times ratio_newuser_t1(i, t-1) \\
 &+ \beta_1 \times is_weekend(i, j, t) + \beta_2 \times is_noonbreak(i, j, t) \\
 &+ \beta_3 \times is_quitting(i, j, t) + \beta_4 \times is_bedtime(i, j, t) + \beta_5 \times is_first(i, j, t) \\
 &+ \gamma_1 \times account_type(i) + \gamma_2 \times is_notmorethan15(i, j, t) + \gamma_3 \times is_emotional(i, j, t) \\
 &+ \theta_1 \times ratio_comment_t1(i, t-1) + \theta_2 \times ratio_like_t1(i, t-1) \\
 &+ \theta_3 \times ratio_favor_t1(i, t-1) + \theta_4 \times ratio_share_t1(i, t-1) + \varepsilon_1
 \end{aligned} \tag{1}$$

By shifting the items of the total number of subscribed users $cumulate_user(i, t)$ on the day, the following formula can be obtained (2):

$$\begin{aligned}
 \log[read_num(i, j, t)] &= \log[cumulate_user(i, j, t)] \\
 &+ \alpha_0 + \alpha_1 \times ratio_newuser(i, t) + \alpha_2 \times ratio_newuser_t1(i, t-1) \\
 &+ \beta_1 \times is_weekend(i, j, t) + \beta_2 \times is_noonbreak(i, j, t) \\
 &+ \beta_3 \times is_quitting(i, j, t) + \beta_4 \times is_bedtime(i, j, t) + \beta_5 \times is_first(i, j, t) \\
 &+ \gamma_1 \times account_type(i) + \gamma_2 \times is_notmorethan15(i, j, t) + \gamma_3 \times is_emotional(i, j, t) \\
 &+ \theta_1 \times ratio_comment_t1(i, t-1) + \theta_2 \times ratio_like_t1(i, t-1) \\
 &+ \theta_3 \times ratio_favor_t1(i, t-1) + \theta_4 \times ratio_share_t1(i, t-1) + \varepsilon_1
 \end{aligned} \tag{2}$$

Next, we will take life, entertainment and information as the research objects, and establish negative binomial regression equation, as follows (3), in order to identify the main factors affecting the click-through reading rate of different types of articles (k = 1, 2, 3), and to sum up and compare the significant factors according to the actual situation.

$$\begin{aligned}
 \log[read_num_k(i, j, t)] &= \log[cumulate_user_k(i, j, t)] \\
 &+ \alpha_{0k} + \alpha_{1k} \times ratio_newuser_k(i, t) + \alpha_{2k} \times ratio_newuser_t_{1k}(i, t-1) \\
 &+ \beta_{1k} \times is_weekend_k(i, j, t) + \beta_{2k} \times is_noonbreak_k(i, j, t) \\
 &+ \beta_{3k} \times is_quitting_k(i, j, t) + \beta_{4k} \times is_bedtime_k(i, j, t) + \beta_{5k} \times is_first_k(i, j, t) \\
 &+ \gamma_{1k} \times account_type_k(i) + \gamma_{2k} \times is_notmorethan15_k(i, j, t) + \gamma_{3k} \times is_emotional_k(i, j, t) \\
 &+ \theta_{1k} \times ratio_comment_t_{1k}(i, t-1) + \theta_{2k} \times ratio_like_t_{1k}(i, t-1) \\
 &+ \theta_{3k} \times ratio_favor_t_{1k}(i, t-1) + \theta_{4k} \times ratio_share_t_{1k}(i, t-1) + \varepsilon_{1k}
 \end{aligned} \tag{3}$$

“Partition-Share & Spread”Model

With the help of negative binomial regression model to describe WeChat users after clicking and reading an article, this paper continues to study the distribution of the occurrence of "Share & Spread" event. Take the sharing amount of the article “j” published by Wechat Official Accounts “I” on the day “t” as an example, the sharing amount is recorded as share_num(i, j, t). The observation time is divided into infinite averages, approximately giving each user who has read this article a period of time to choose whether to continue to share this article with other users. The forwarding and sharing behavior of users who have read in different periods is independent of each other. Then the average number of reads per unit time is share_num(i,j,t)/read_user(i,j,t). That is to say, the forwarding and sharing rate share_ratio(i,j,t) of articles obeys the negative binomial distribution. The main factors affecting forwarding and sharing rate can be studied by establishing a negative binomial regression equation.

The independent and dependent variables in the second stage of FSIPS "Partition-Share & Spread" are introduced into the negative binomial regression equation. The research model is as follows (4):

$$\begin{aligned}
 \log[share_ratio(i, j, t)] &= \log\left[\frac{share_num(i, j, t)}{read_num(i, j, t)}\right] \\
 &= l_0 + l_1 \times ratio_comment(i, j, t) \\
 &+ l_2 \times ratio_like(i, j, t) + l_3 \times ratio_favor(i, j, t) \\
 &+ m_1 \times account_type(i) + m_2 \times conlen_img(i, j, t) \\
 &+ m_3 \times is_includevideo(i, j, t) + m_4 \times middle_relevance(i, j, t) \\
 &+ m_5 \times high_relevance(i, j, t) + \varepsilon_2
 \end{aligned} \tag{4}$$

The reading number read_num(i, j, t) of the articles on the same day is taken as the exposure variable, and the following formula (5) can be obtained by shifting the items.

$$\begin{aligned}
 \log[share_num(i, j, t)] &= \log[read_num(i, j, t)] + l_0 + l_1 \times ratio_comment(i, j, t) \\
 &+ l_2 \times ratio_like(i, j, t) + l_3 \times ratio_favor(i, j, t) \\
 &+ m_1 \times account_type(i) + m_2 \times conlen_img(i, j, t) \\
 &+ m_3 \times is_includevideo(i, j, t) + m_4 \times middle_relevance(i, j, t) \\
 &+ m_5 \times high_relevance(i, j, t) + \varepsilon_2
 \end{aligned} \tag{5}$$

Similar to the research process of the first stage, the next three kinds of articles about life, entertainment and information are respectively established negative binomial regression equation as follows (6), to identify the main factors affecting the forwarding and sharing rate of different types of articles (k = 1, 2, 3), and to compare and analyze the regression equation of different types.

$$\begin{aligned}
 \log[share_num_k(i, j, t)] &= \log[read_num_k(i, j, t)] + l_{0k} + l_{1k} \times ratio_comment_k(i, j, t) \\
 &+ l_{2k} \times ratio_like_k(i, j, t) + l_{3k} \times ratio_favor_k(i, j, t) \\
 &+ m_{1k} \times account_type_k(i) + m_{2k} \times conlen_img_k(i, j, t) \\
 &+ m_{3k} \times is_includevideo_k(i, j, t) + m_{4k} \times middle_relevance_k(i, j, t) \\
 &+ m_{5k} \times high_relevance_k(i, j, t) + \varepsilon_{2k}
 \end{aligned} \tag{6}$$

RESULT ANALYSIS

Through STATA15 to complete two stages of negative binomial regression analysis, we summarized and compared the main influencing factors of the dissemination effect of three types of WeChat Official Accounts articles.

Empirical Analysis of the First Stage

Overall, 2969 descriptive statistics of 21 Wechat Official Accounts in three months are shown in Table 3. Among them, 1169 are life, 648 are entertainment and 1152 are information.

The average number of subscribed users to Official Accounts is 551,000, the maximum number of subscribed users is 1.25 million, and the minimum subscribed users is 29,670. The proportion of new users added in one day can reach 18.8%. The average number of reading a single article is 102,000, with a maximum of 218,000 and a minimum of 8,237. 32.3% of the articles are in the headlines. 26% of articles were pushed on weekends; 41.3% of articles were pushed on weekends (17:30-20:00), while 20.3% were pushed on bedtime (21:30-23:30), 27% of the titles of public documents are less than 15 words.

For the feedback effect of Official Accounts, the average values of comment rate, Like rate, favor rate and share rate on the previous day were between 11.5% and 15.5%.

Table 3 : Descriptive Statistical Results of the Overall Data in the overall data

Variable	Obs	Mean	Std.Dev.	Min	Max
account_type	2969	1.994	.884	1	3
is_includevideo	2969	.135	.342	0	1
ratio_comment	2969	.002	.003	0	.079
ratio_like	2969	.012	.015	0	.127
ratio_favor	2969	.008	.011	0	.176
read_num	2969	8237.715	10171.36	19	218000
share_num	2969	265.551	621.426	0	16091
conlen_img	2969	191.719	278.85	0	5652.5
middle_relevance	2969	.089	.285	0	1
high_relevance	2969	.378	.485	0	1

The negative binomial regression results of the overall data show that the result of "LR test of alpha = 0" is significant, so we should choose the negative binomial regression model when the overall data in the first stage is over-discrete.

According to the IRR value ($IRR = \exp(\text{Coef.})$) in Table 4, we can see that besides the type of Wechat Official Accounts, if the article title contains emotional symbols, the push position is the headline, and the overall comment rate and the comment rate of the previous day passed the significance test of 99% confidence, the read rate of the articles will be positively affected; If push time is at bedtime, the title of the article does not exceed 15 words, the overall favor rate of Wechat Official Accounts the day before passed the significance test of 95% confidence, the read rate of the articles will be positively affected; At the 90% confidence level, push time (17:30-20:00) would have a positive impact on articles in the off-duty time (17:30-20:00).

Table 4 : Negative Binomial Regression Results of Overall Data on the First Stage

read_num	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
1b.account_type	1.000	.	.	.	.	.
2.account_type	1.303	0.056	6.11	0.000	1.197	1.418	***
3.account_type	0.567	0.020	-16.33	0.000	0.530	0.607	***
ratio_newuser	0.724	1.563	-0.15	0.881	0.011	49.735	
ratio_newuser_t1	0.297	0.543	-0.66	0.507	0.008	10.724	
is_weekend	1.025	0.028	0.91	0.364	0.972	1.080	
is_noonbreak	1.051	0.124	0.42	0.671	0.835	1.324	
is_quitting	1.056	0.035	1.66	0.098	0.990	1.126	*
is_bedtime	0.949	0.036	-6.39	0.035	0.881	1.022	**
is_emotional	0.874	0.021	-5.55	0.000	0.833	0.916	***
is_first	3.048	0.077	43.94	0.000	2.901	3.204	***
is_notmorethan15	0.941	0.025	-2.27	0.023	0.893	0.992	**
ratio_comment_t1	1.52E-09	3.89E-09	-7.94	0.000	1.01E-11	2.29E-07	***

ratio_like_t1	4.14E+10	6.14E+10	16.50	0.000	2.27E+09	7.56E+11	***
ratio_favor_t1	0.013	0.024	-2.32	0.020	0.000	0.507	**
ratio_share_t1	0.840	0.492	-0.30	0.766	0.267	2.646	
Constant	0.009	0.000	-97.31	0.000	0.008	0.010	***
lnalpha	-0.903	0.024	.b	.b	-0.951	-0.855	
Mean dependent var	8237.715		SD dependent var		10171.365		
Pseudo r-squared	0.043		Number of obs		2969.000		
Chi-square	2477.398		Prob > chi2		0.000		
Akaike crit. (AIC)	55496.239		Bayesian crit. (BIC)		55598.170		
LR test of alpha=0: chibar2(01) = 7.9e+06 Prob >= chibar2 = 0.000							

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The descriptive statistical results of the life Official Accounts are shown in table 5 below. Of the 1169 background operating data, 34.6% of the articles were in the headlines. 26% of articles were pushed on weekends; 13.7% were pushed at bedtime (21:30-23:30), and 16.3% were pushed at off-duty time (17:30-20:00). 20.2% of the titles of the articles were controlled within 15 words.

For the feedback effect of Wechat Official Accounts information dissemination, the average comment rate, Like rate, favor rate and share rate of articles on the previous day were between 10.5% and 13.0%.

The negative binomial regression results of life Official Accounts are also too discrete, so the negative binomial regression model is chosen.

The article title contains emotional symbols, the push position is the headline, and the overall comment rate and Like rate of Wechat Official Accounts the day before still passed the significance test of 99% confidence. At the same time, push time for bedtime also has a very significant positive impact on reading rate.

Table 5 : Descriptive Statistics of the Life Official Accounts in the First Stage

Variable	Obs	Mean	Std.Dev.	Min	Max
cumulate_user	1169	410000	212000	89333	651000
ratio_newuser	1169	0	.001	0	.009
ratio_newuser_t1	1169	0	.001	0	.009
is_weekend	1169	.262	.44	0	1
is_noonbreak	1169	.011	.105	0	1
is_quitting	1169	.163	.369	0	1
is_bedtime	1169	.137	.344	0	1
is_emotional	1169	.577	.494	0	1
is_first	1169	.346	.476	0	1
is_notmorethan15	1169	.202	.402	0	1
ratio_comment_t1	1169	.09	.283	0	1
ratio_like_t1	1169	.106	.279	0	1
ratio_favor_t1	1169	.095	.281	0	1
ratio_share_t1	1169	.127	.274	.001	1
read_num	1169	8854.151	9665.223	112	122000

Unlike the regression results of the overall data, the title not exceeding 15 words and overall favor rate of Wechat Official Accounts no longer had a significant positive impact on the reading rate of the push articles. At 90% confidence level, the proportion of new users on the same day will positively affect the reading rate of push articles.

Table 6 : Negative Binomial Regression Results of Life Official Accounts in the First Stage

read_num	IRR	St.Err.	t-value	p-value	[95% Conf Interval]	Sig
ratio_newuser	4.950E+29	1.940E+31	1.75	0.081	0.000	1.080E+63 *
ratio_newuser_t1	6.730E+17	2.310E+19	1.20	0.231	0.000	9.360E+46
is_weekend	1.042	0.041	1.03	0.303	0.964	1.126
is_noonbreak	1.046	0.176	0.27	0.788	0.752	1.456

is_quitting	0.934	0.046	-1.37	0.171	0.848	1.030	
is_bedtime	0.651	0.035	-7.97	0.000	0.586	0.724	***
is_emotional	0.901	0.032	-2.92	0.003	0.841	0.966	***
is_first	2.401	0.090	23.33	0.000	2.231	2.584	***
is_notmorethan15	0.993	0.043	-0.16	0.874	0.912	1.082	
ratio_comment_t1	2.71E-10	8.83E-10	-6.76	0	4.57E-13	1.61E-07	***
ratio_like_t1	2.27E+10	3.75E+10	14.47	0	8.99E+08	5.75E+11	***
ratio_favor_t1	0.288	0.759	-0.47	0.637	0.002	50.157	
ratio_share_t1	0.613	0.439	-0.69	0.494	0.151	2.492	
Constant	0.009	0.001	-80.50	0.000	0.008	0.011	***
lnalpha	-1.056	0.039	.b	.b	-1.133	-0.979	
Mean dependent var		8854.151	SD dependent var			9665.223	
Pseudo r-squared		0.034	Number of obs			1169.000	
Chi-square		773.254	Prob > chi2			0.000	
Akaike crit. (AIC)		21997.120	Bayesian crit. (BIC)			22073.079	
LR test of alpha=0: chibar2(01) = 2.4e+06			Prob >= chibar2 = 0.000				

Similarly, in 648 background operating data of entertainment Official Accounts, for the feedback effect of Wechat Official Accounts information dissemination, the average comment rate, Like rate, favor rate and share rate on the previous day were about 21%. At 99% confidence level, the title control was within 15 words and the push position was the headline. At the same time, at 95% confidence level, push time at bedtime (21:30-23:30) positively affects the reading rate of articles; at 90% confidence level, the proportion of new users at the previous day and articles pushed over the weekend has a significant positive impact on the reading rate. Controlling the number of characters to less than 15 words no longer has a significant positive impact on the reading rate of articles.

There are 1152 articles of information Official Accounts. The average comment rate, Like rate, favor rate and share rate of Wechat Official Accounts on the previous day are between 9% and 14%. For information Official Accounts, the proportion of new users added to the Official Account on that day, the position of push is the headline, the time of push is the bedtime period, and the number of titles of articles does not exceed 15 words, all of these conditions passed the significance test of 99% confidence. Comparatively, among the factors of feedback effect of the previous day's Official Account information dissemination, only the overall Like rate will have a positive impact on the reading rate, while the overall comment rate, favor rate and share rate have not passed the significant test.

Empirical Analysis of the Second Stage

According to the statistical results of the second stage of 2969 push articles from 21 Wechat Official Accounts (as shown in Table 7 below), the average number of share of single push articles is 266, up to 161,000.

About the content vividness, 13.5% of the articles contain multimedia information such as video; the average ratio of text to picture is 192, that is to say, an average of 192 text texts will contain 1 picture.

About the content relevance, 37.8% of the text is highly correlated with its title, and 8.9% of the text is moderately correlated with its title.

From the pre-effect of Official Accounts information dissemination, the average comment rate of Official Accounts push articles is the lowest, only 0.2%, followed by the favor rate, which is 0.8%, while the average Like rate is relatively high, which is 1.2%.

Table 7: Descriptive Statistics of Overall Data in the Second Stage

Variable	Obs	Mean	Std.Dev.	Min	Max
account_type	2969	1.994	.884	1	3
is_includevideo	2969	.135	.342	0	1
ratio_commmnt	2969	.002	.003	0	.079
ratio_like	2969	.012	.015	0	.127
ratio_favor	2969	.008	.011	0	.176
read_num	2969	8237.715	10171.36	19	218000
share_num	2969	265.551	621.426	0	16091
conlen_img	2969	191.719	278.85	0	5652.5
middle_relevance	2969	.089	.285	0	1

high_relevance	2969	.378	.485	0	1
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In the second stage, "LR test of alpha = 0" is still significant, so the overall data in the second stage is still excessively discrete and should continue to use the negative binomial regression model.

According to the IRR value (IRR = exp (Coef.)) of Table 8, we can see that the independent variable of Official Account type passed the significance test with 99% confidence, which had a significant impact on the share rate of articles. Under the same conditions, the information Official Accounts (IRR = 0.050) had the best sharing effect, followed by the entertainment Official Accounts (IRR = 0.018).

From the dimension of the content vividness, at 99% confidence level, content containing video and multimedia information will have a significant positive impact on the share rate, while the ratio Of text to picture has not passed the significance test.

As for the dimension of the content relevance, the high correlation between content and its title will positively affect the share rate at 99% confidence level, while the moderate correlation between content and its title will positively affect the share rate at 90% confidence level.

In the pre-effect dimension of information dissemination, both the Like rate and the favor rate passed the significance test of 99% confidence, which had a significant positive impact on the share rate, while the related impact of comment rate was not significant. However, by comparing the IRR values of the two independent variables, the positive unit effect of the favor rate is much higher than the positive unit effect of the favor rate.

Table 8: Negative Binomial Regression Results of Life Official Account in the Second Stage

share_num	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
1b.account_type	1.000	.	.	.	.	.
2.account_type	0.394	0.018	-20.59	0.000	0.361	0.431	***
3.account_type	1.254	0.050	5.70	0.000	1.160	1.355	***
is_includevideo	1.564	0.073	9.64	0.000	1.428	1.713	***
ratio_comment	2079.668	14306.136	1.11	0.267	0.003	1490000000	
ratio_like	0.000	0.000	-7.50	0.000	0.000	0.001	***
ratio_favor	1.160e+20	2.440e+20	21.95	0.000	1.870e+18	7.170e+21	***
conlen_img	1.000	0.000	1.31	0.191	1.000	1.000	
middle_relevance	0.910	0.052	-1.66	0.097	0.814	1.017	*
high_relevance	1.122	0.038	3.43	0.001	1.050	1.198	***
Constant	0.021	0.001	-83.98	0.000	0.019	0.023	***
lnalpha	-0.363	0.024	.b	.b	-0.411	-0.315	
Mean dependent var		265.551	SD dependent var			621.426	
Pseudo r-squared		0.046	Number of obs			2969.000	
Chi-square		1626.156	Prob > chi2			0.000	
Akaike crit. (AIC)		33940.189	Bayesian crit. (BIC)			34006.144	
LR test of alpha=0: chibar2(01) = 6.0e+05 Prob >= chibar2 = 0.000							

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The descriptive statistical results of 1169 articles from 8 life Wechat Official Accounts in the second stage can be found in Table 9. The average number of individual share was 317, with a maximum of 106,000. Among them, 17.1% of the articles contain video information; the average ratio of text to picture is 100. From the correlation dimension of the article content, 34% of the articles are highly related to their titles, while 9.3% of the articles are moderately related to their titles. The average comment rate is still the lowest, only 0.2%; the second is the average favor rate, which is 0.8%; and the average Like rate is the highest, which is 2%.

The negative binomial regression results of the Life Official Accounts in the second stage can be seen in Table 10 below.

From the dimension of the content vividness, at the level of 99% confidence, the content of articles including video multimedia information and text-to-picture ratio will have a significant positive impact on the article share rate.

Table 9: Negative Binomial Regression Results of Life Official Account in the Second Stage

Variable	Obs	Mean	Std.Dev.	Min	Max
is_includevideo	1169	.171	.377	0	1
ratio_comment	1169	.002	.002	0	.035

ratio_like	1169	.02	.021	0	.127
ratio_favor	1169	.008	.011	0	.079
read_num	1169	8854.151	9665.223	112	122000
share_num	1169	316.695	683.777	0	10611
middle_relevance	1169	.093	.291	0	1
high_relevance	1169	.34	.474	0	1
conlen_img	1169	100.113	213.936	0	5652.5

From the dimension of the content relevance, unlike the regression results of the overall data in the second stage, the two independent variables (high correlation, moderate correlation) of Life Official Accounts failed to pass the significance test.

About the pre-effect of Official Accounts information dissemination, besides the Like rate and favor rate of push articles passed the prominence test of 99% confidence, the comment rate also passed the prominence test. By comparing the IRR values of three independent variables, it was found that the positive unit effect of the favor rate was higher than that of the comment rate, which was much higher than that of the Like rate.

Table 10: Negative Binomial Regression Results of Life Official Account in the Second Stage

share_num	IRR	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
is_includevideo	1.357	0.094	4.39	0.000	1.184	1.555	***
ratio_comment	3.800e+16	4.980e+17	2.91	0.004	261000.000	5.510e+27	***
ratio_like	0.000	0.000	-6.72	0.000	0.000	0.001	***
ratio_favor	2.200e+25	8.100e+25	15.84	0.000	1.610e+22	3.000e+28	***
conlen_img	1.001	0.000	5.40	0.000	1.001	1.002	***
middle_relevance	0.863	0.081	-1.57	0.116	0.718	1.037	
high_relevance	1.081	0.064	1.33	0.183	0.964	1.213	
Constant	0.017	0.001	-58.61	0.000	0.015	0.019	***
lnalpha	-0.253	0.038	.b	.b	-0.328	-0.178	
Mean dependent var		316.695		SD dependent var		683.777	
Pseudo r-squared		0.043		Number of obs		1169.000	
Chi-square		621.665		Prob > chi2		0.000	
Akaike crit. (AIC)		13690.566		Bayesian crit. (BIC)		13736.142	

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Similarly, the average number of share from the individual articles of Entertainment Wechat Official Accounts is 116, with a maximum of 1154. The average Like rate, favor rate and comment rate ranged from 0.2% to 0.8%. The average Like rate was the highest, significantly higher than the favor rate and comment rate. According to the IRR value calculation results, at the 99% confidence level, the positive influence of article containing video multimedia information (IRR=2.018) is higher than that of the text-to-picture ratio (IRR=0.999); in the content relevance dimension, high correlation and moderate correlation will have a significant positive impact on the article share rate, high correlation (IRR = 1.264) articles have more positive unit influence than moderate correlation (IRR = 0.751). It is noteworthy that the positive unit influence of the Like rate (IRR = 1.830E + 25) of Entertainment Official Accounts is significantly higher than that of the Life Official Accounts (IRR = 0.000). Among the three independent variables of the favor rate, the comment rate and the Like rate of Entertainment Official Accounts, the positive unit effect of the favor rate is higher than Like rate, and the Like rate is higher than the comment rate.

The average number of individual articles shared in Information Official Accounts is 298, with a maximum of 161,000. Among them, the average Like rate, favor rate and comment rate is between 0.1% and 1.2%, but the average favor rate is the highest, significantly higher than the Like rate and comment rate. At 99% confidence level, video multimedia information and text-to-picture ratio have a significant positive impact on the article share rate. Only one independent variable with high correlation passed the 90% significance test. At a certain level of confidence, the comment rate, favor rate and comment rate of push articles will have a positive impact on the share rate. The positive unit effect of comment rate is higher than the favor rate, which is far higher than the comment rate.

Comparison of Influencing Factors of Different Types of WeChat Official Accounts in Two Stages

Previous studies by scholars have found that the popularity of articles in Official Accounts is related to the theme to some extent, and the reading amount is also affected by the type of articles. We substitute the WeChat Official Accounts type into the negative binomial regression equation as the classification variable. The calculation results of STATA 15 show that, at the confidence level of 99%, the independent variable WeChat Official Accounts type will have a significant impact on the reading rate of articles pushed by the dependent variable. According to the IRR value, the positive influence of the three Official Accounts is:

entertainment > life > information, that is, under the same conditions, the number of articles read by the entertainment public accounts will be higher than that of life accounts, and the number of articles read by the life public accounts will be higher than that of information accounts.

Table 11: The influence of WeChat Official Accounts type in the first stage

Read_num	IRR	St.Err.	T-value	P-value	Sig
1.account_type	1				
2.account_type	1.303	0.056	6.11	0	***
3.account_type	0.567	0.02	-16.33	0	***

When the information dissemination enters the second stage, the order of positive influence of the three public accounts is changed into: information > life > entertainment. The difference between the two stages is reasonable, because the depth of user participation in the second stage is higher than that in the first stage. In the first stage, articles published by the entertainment Official Accounts can better meet WeChat users' demand for relaxation and entertainment. In the second stage, WeChat users are more inclined to consider the information value of articles on the Official Accounts. Therefore, the information Official Accounts plays the first role in promoting the effect of article sharing.

Table 12: The influence of WeChat Official Accounts type in the second stage

Read_num	IRR	St.Err.	T-value	P-value	Sig
1.account_type	1				
2.account_type	0.394	0.018	-20.59	0	***
3.account_type	1.254	0.05	5.7	0	***

From the perspective of influencing factors, according to the following table, for "Sympathy under reverse-identify", independent variables in the following four dimensions all have a significant impact on the rate of article reading.

First is the new users dimension. For the purpose of obtaining effective information, the percentage of new users in the information (99% confidence level) and life (90% confidence level) will have a significant positive impact on the reading rate of articles.

Second is the push environment dimension. Firstly, time is an important factor influencing the information transmission. The push time can significantly improve the reading rate of articles before bed time. Secondly, push location has a significant positive impact on the number of reads, which has also been verified in our experiment.

Next is the external content perception dimension. As a typical external feature, the title length of the article on the Official Accounts affects the click rate to some extent. Also, whether the title contain emotional punctuation ("? !") or not will significantly affect the life and information of the Official Accounts of the article reading rate.

Final is the feedback influence dimension. The overall comment rate of the WeChat Official Accounts on the previous day will significantly improve the reading rate of articles on the same day by the Official Accounts of life and entertainment, especially for entertainment (IRR is extremely high).

Table 13: Comparison of Significance Test Results of Independent Variables in the First Stage

Independent variables	1. Life		2. Entertainment		3. Information	
	IRR	Sig	IRR	Sig	IRR	Sig
ratio_newuser	4.95E+29	*	0.439		3.80E+279	***
ratio_newuser_t1	6.73E+17		0.098	*	8.50E-54	
is_weekend	1.042		0.924	*	1.068	
is_noonbreak	1.046		1.262		0.71	
is_quitting	0.934		1.092		0.946	
is_bedtime	0.651	***	0.854	**	1.179	***
is_emotional	0.901	***	0.966		0.848	***
is_first	2.401	***	2.376	***	4.643	***
is_notmorethan15	0.993		0.862	***	1.009	
ratio_comment_t1	2.71E-10	***	1.49E+13	***	4.54E-07	
ratio_like_t1	2.27E+10	***	2.276		6613915	*
ratio_favor_t1	0.288		0	***	0.055	
ratio_share_t1	0.613		0	***	3.731	

For "Partition-Share & Spread" , the second stage, there are independent variables in the two dimensions of internal content judgment (content relevance, content vividness) and the article dissemination effect in the previous stage (comment rate, favor rate and share rate) that will affect the article share rate.

From the perspective of content relevance of content judgment dimension, the positive influence of article sharing rate of entertainment Official Accounts has been verified, and the unit efficacy of highly correlated independent variable is higher than that of medium correlation, which conforms to the normal law. At the same time, at the 90% confidence level, the article share rate of information Official Accounts is only positively affected by highly correlated independent variables. This also explains to a certain extent that while the entertainment Official Accounts attaches importance to the fun and entertainment, but it cannot simply rely on exaggerated title to attract people's attention, which may have a negative impact on the deep spread and diffusion effect of pushing articles.

In addition, previous relevant studies have shown that WeChat users' favor behavior meets users' needs and can provide a resource basis for information sharing in the future. Combined with the significance level and IRR value, the share rate of articles in the three types of Official Accounts will be positively affected by the article favor rate. Vertically, the influence of the communication effects in the previous stage on the share rate of articles is as follows:

- Life Official Accounts: Favor rate > Comment rate >> Like rate
- Entertainment Official Accounts: Favor rate > Comment rate
- Information Official Accounts: Like rate > Favor rate >> Comment rate

The above situation also reflects that the favor behavior can better reflect the positive attitude of WeChat users. The operators of the three types of Official Accounts should pay more attention to the favor indicators of articles and take into account the other two indicators.

Table 14: Comparison of Significance Test Results of Independent Variables in the Second Stage

Independent variables	1. Life IRR	2. Entertainment		3. Information	
		IRR	Sig	IRR	Sig
is_includevideo	1.36E+00	***	2.018	***	1.24E+00 ***
ratio_comment	3.80E+16	***	9.55E+11		3.15E-07 **
ratio_like	0	***	1.83E+25	***	1.46E+15 ***
ratio_favor	2.20E+25	***	6.61E+55	***	1.55E+11 ***
conlen_img	1.001	***	0.999	***	1 **
middle_relevance	0.863		0.751	**	1.022
high_relevance	1.081		1.264	***	1.073 *

RESEARCH CONCLUSION

To sum up, the results of the study of "Sympathy under reverse-identify" are as follows:

1. WeChat Official Accounts type: Official Accounts type has a significant impact on the read rate of articles. Other things being equal, the positive influence of three types of Official Accounts is: Entertainment > Life > Information.
2. New users dimension: the ratio of daily new users in information and life Official Accounts will have a significant positive impact on the read rate of articles.
3. Article environment dimension: push time before bed time and push position in the headlines will significantly improve the read rate of articles.
4. External content perception dimension: the number of title words is less than 15 words, which can significantly improve the read rate of articles in the entertainment Official Accounts. Whether the title of the article contain emotional punctuation ("? !") or not will significantly affect the read rate of the life and information Official Accounts.
5. Feedback influence dimension on the previous day: the overall comment rate of the Official Accounts on the previous day will significantly improve the read rate of articles pushed by life and entertainment Official Accounts. The overall Like rate will positively affect the read rate of articles pushed by life and information Official Accounts.

In "Partition-Share & Spread", the second stage, this study quantitatively analyzed the pre-spread effects such as article comment rate, Like rate and favor rate, as well as the influence of article internal characteristics on its sharing effect. The research results are as follows:

1. WeChat Official Accounts type: under the same conditions, the positive influence ranking of the three types of Official Accounts is: Information > Life > Entertainment.
2. Internal content judgment (content relevance, content vividness) : the content of the article contains video information, which will significantly improve the share rate of articles of three types of Official Accounts. The high and medium correlation between

the content and title promotes the share rate, while the share rate on the information Official Accounts is only positively affected by the highly correlated independent variable.

3. The article communication effects of the previous stage (comment rate, favor rate and share rate) : the article favor rate has a significant promotion effect on the share rate of articles of the three types of Official Accounts.

LIMITATIONS & PROSPECTS

In this study, the authenticity, scientificity and validity of experimental data and experimental methods are guaranteed. However, due to the low posting frequency of some WeChat Official Accounts, and the uncertain position of the WeChat users in information dissemination and the complex transformation mechanism of the users' concern behavior, this study still has some limitations.

If possible, we can try to establish a mapping mechanism between title and hot topic to observe whether the correlation can promote the click and read behavior of users. We can also explore a new algorithm to calculate the matching degree of keywords between title and content, and gradually improve the judgment efficiency of the relevance between them.

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Research on Operation Mode and Risk Prevention of B2B Supply Chain Finance

(Full Paper)

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ABSTRACT

B2B supply chain finance is the business innovation of e-commerce enterprises in the field of transforming supply chain finance. E-commerce platform, supply chain enterprises and service providers are important participants in B2B supply chain finance. Four flow coordination, credit enhancement, technology empowerment and win-win situation are the key elements of B2B supply chain finance. In view of the external environmental risks faced by the B2B supply chain finance operation at this stage and the structural risks, fund-side risks, technical risks and risks of collateral generated within the system, we put forward the formulation of external environmental risk early warning and response mechanism, the improvement of relevant legal system design, the scientific design of business processes, the strengthening of platform financial management, the improvement of technical application level and collateral supervision management system and other governance strategies in this paper.

Keywords: B2B supply chain finance, credit enhancement, risk prevention and control.

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INTRODUCTION

In 2018, there were 688 e-commerce investment and financing events in China. Among them, there are 135 B2B e-commerce events (including FMCG e-commerce, industrial e-commerce, steel e-commerce, plastic e-commerce, etc.), accounting for 20%; the investment and financing amount was 2196.92 million yuan, including 30.04 billion B2B e-commerce events, accounting for 14%. In recent years, with the development of Internet and big data technologies, many B2B e-commerce platforms in China have begun to transform the supply chain finance business and have driven a large number of enterprises online (Dou & Zheng, 2019). B2B supply chain finance is a business innovation of e-commerce platform based on Internet of Things, big data, blockchain and other new technologies to carry out supply chain finance. It breaks through the weak credit of the financing party by virtue of the advantage resources gathered by the e-commerce platform and provides credit and financing services for the enterprises with insufficient funds in the platform.

B2B supply chain financing is essentially a category of Internet supply chain finance. It is a new field for e-commerce enterprises to innovate and develop financial business. According to the different functions of e-commerce enterprises in the supply chain finance platform, B2B supply chain finance operation model can be divided into service type and self-management model, as shown in Figure 1. In the service model, e-commerce enterprises are responsible for the construction of the trading platform. According to the risk control standards and pricing of external financial institutions, they push the financing intention of the platform enterprises, and they do not bear the financing risks related to lending. In the self-management model, e-commerce enterprises play a dual role of platform builder and financial institutions, independently develop platform financing products, determine risk control rules, and bear the corresponding lending risk. Obviously, in the service model, e-commerce enterprises cannot really integrate into the supply chain industry ecology, and the credit certification and risk control system are difficult to be guaranteed. In the self-management model, e-commerce enterprises participate in and monitor the entire process from the selection of suppliers to the signing of commodity warranty, delivery and capital settlement with suppliers, so the self-management model of B2B supply chain finance is more consistent with the requirements of business ecology. In this paper, taking the self-management model of B2B supply chain finance as the research object, we analyze the participants and function design of B2B supply chain finance, discuss the key elements of the sound operation of B2B supply chain finance, and put forward corresponding prevention strategies for the possible risk problems in the operation.

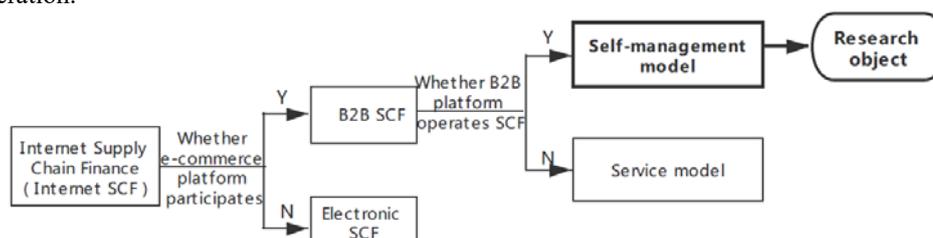


Figure 1: Classification of supply chain finance

OPERATIONAL DESIGN OF B2B SUPPLY CHAIN FINANCE

Under B2B supply chain finance, e-commerce enterprises rely on the new generation of IT technology to build a new supply chain ecosystem, and use their own good credit utilization advantages to introduce credit from banks and other financial institutions, and provide financing services to small and medium-sized micro node enterprises such as suppliers and distributors operating in the platform through the corresponding credit system and risk assessment system. The specialization and platform of participants are the development direction of supply chain finance (Song, 2019). Due to the penetration and utilization of Internet technology, the participants in the B2B supply chain finance system have been greatly expanded. As shown in Figure 2, the upstream suppliers and downstream distributors of the supply chain are no longer the traditional simple chain relationships, but all form a complex cluster network of interaction; the supporters of supply chain finance activities such as governments, financial institutions and logistics organizations also present comprehensive and complex errors. The benefit related relationship, and thus derived more service channels, and these functional relationships can also provide reliable mutual confirmation for the operation of B2B supply chain finance, greatly reducing the operational risk of the platform business. In the complex network system structure, e-commerce enterprise is the neural hub. Through the Internet platform, we can master the business flow, capital flow, logistics and information flow of supply chain operation, be familiar with the operation key and pain point of the whole supply chain system, and timely provide the platform enterprise with corresponding supporting services including financing, so that all kinds of economic entities in the system structure can focus on development. Its core competitiveness, and then improve the overall competitive advantage of the supply chain network system.

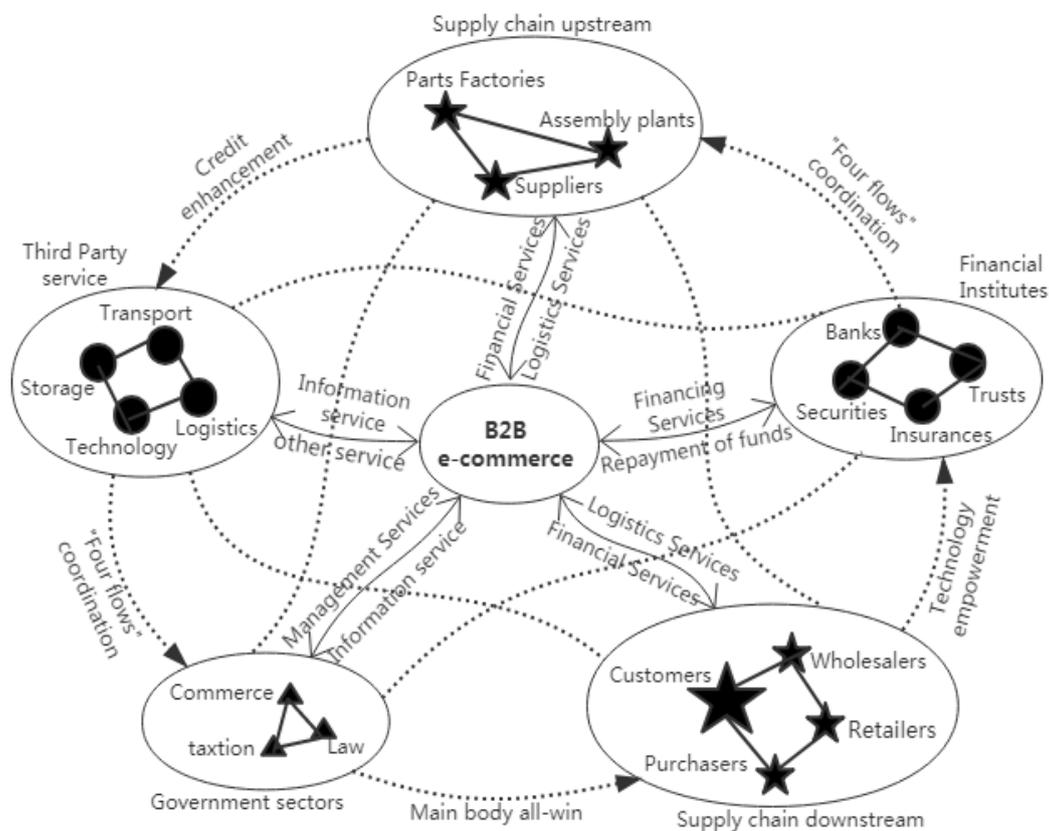


Figure 2: Platform of B2B supply chain finance

Participants And Functions

B2B e-commerce enterprise

B2B e-commerce enterprises are the nerve center of supply chain finance. It masters the business flow, capital flow, information flow and logistics (hereinafter referred to as "four flows") of the entire platform operation. The e-commerce platform is familiar with the key operations and pain points of the entire supply chain system, and leads the network structure, transaction process and element management of the supply chain finance ecosystem. Its main function is to establish information bridges for various types of participants, and provide fund matching, credit rating, credit guarantee, payment and settlement and other financial services for node companies in the platform. In addition, B2B e-commerce companies will also rely on their strong business strength and good reputation to introduce government, asset evaluation, logistics organization and other supporters of supply chain finance activities to the platform to provide comprehensive integrated services for SMEs in the supply chain. The B2B e-commerce platform has established a fair and just trading place for the service group, and also created conditions for strategic cooperation of mutual reciprocity between enterprises. Its profit comes from the reduction of information costs, the simplification of work processes, the saving of transaction costs, and the Benefits of value chain integration.

Supply chain enterprises

Supply chain enterprises refer to the upstream and downstream enterprises that trade on the B2B platform, and they are also the main objects of supply chain finance services. Under the service support of the platform, supply chain enterprises have formed several horizontal cluster chains and vertical industrial chains. Horizontal cluster chain and vertical industrial chain form an organic coupling between industrial cluster and supply chain. There are many parallel single chain supply chains. These single chains not only include the cooperation between upstream and downstream enterprises, but also the coordination and cooperation between single chains (Liu, Guo, & Li, 2011). It should be noted that in the horizontal cluster chain operation process, e-commerce companies need to innovate the management of the cluster network system, build a common vision for the cluster, enhance the dependence and stickiness of the cluster members on the e-commerce platform, and manage suppliers or distributors. The operation process of each horizontal cluster chain enables each cluster to form an orderly industrial division of labor in the platform. In the vertical industrial chain operation process, e-commerce companies need to manage a chain relationship between upstream suppliers and downstream distributors by building a series of contract mechanisms. First of all, it is necessary to conduct on-site inspections of the products of suppliers cooperating in the e-commerce platform, ensure the quality of the platform products from the source, and sign contracts for many links such as supply, pricing, settlement, and delivery; second, use the O2O business model to open The distribution channel ensures that the mall and the O2O showroom products are seamlessly connected, increasing the customer experience and purchasing convenience, and increasing the sales success rate. Promote the efficient operation of vertical value chains through highly cooperative joint actions of upstream and downstream enterprises.

Service provider

Service provider refers to the organization that provides capital, logistics, value evaluation and other services for supply chain enterprises on the platform. Among them, financial institutions provide financial products or services for enterprises, formulate finance service business models and programs; logistics enterprises provide comprehensive third-party logistics services such as custody and supervision of pledged goods, warehousing, transportation, etc., and provide help for financial institutions to more easily grasp various transactions of enterprises. The asset evaluation institution is responsible for the value evaluation of the inventory, intellectual property, financial products and other pledges on the platform. Government departments provide various services for platform enterprises, such as industry and commerce, taxation, customs, etc. These entities together form a platform service chain to provide various services for the supply chain enterprises, which is conducive to the enterprises to focus on their core competitiveness and improve the overall competitive advantage of the supply chain. Service providers form a complex network of service relationships through the platform's sharing mechanism. The service effectiveness of the service chain to supply chain node companies reflects the platform's leading and coordination capabilities to a certain extent. The interaction of horizontal cluster chain, vertical industry chain and service chain has promoted the symbiotic development of the supply chain finance ecosystem and opened up a broad space for B2B supply chain finance business.

Key Elements Of Healthy Operation

"Four flows" coordination

Supply chain finance is based on the supply chain management activities. In the operation of the supply chain, it takes advantage of the overall consideration of the "four flows" of the supply chain (Song & Yang, 2018). The financing organizer provides a series of comprehensive financial services to fund demanders through special financing designs. "Four flows" run through every transaction link of B2B supply chain finance platform. The disordered coordination of "four flows" will lead to the failure of platform transaction design and bring huge risks to supply chain finance. Therefore, timely logistics distribution, compliance of business flow transfer, real and smooth information flow and stable matching of capital flow are important prerequisites for the sound operation of B2B supply chain finance. E-commerce enterprises should actively use block chain, big data, Internet of Things and other new technologies to realize the organic coordination of the "four flows" of the supply chain and create value for the participants of the supply chain.

Credit enhancement

The credit enhancement under the traditional supply chain finance is a one-to-one chain transmission with the help of the good credit resources of the core enterprises to achieve a breakthrough in the weak credit of the small and medium-sized enterprises. The credit of the core enterprises can only be transferred to the upstream and downstream enterprises that directly trade with them. The constraint of credit penetration makes the multi-level SMEs at the long end of the supply chain unable to enjoy the real supply chain finance services (Ye, 2019) Under the B2B supply chain finance mode, through the application of digital technology, the credit advantages of e-commerce platform and core enterprises can be transmitted to several levels of small and medium-sized enterprises that have transactions on the platform. This platform based on credit transmission mode enhances the credit of more financing enterprises and effectively expands the service objects of B2B supply chain finance. In addition, B2B supply chain finance relies on the supply chain ecosystem to achieve a high degree of integration of the three major elements of "e-commerce + supply chain + finance". It can not only play a role in improving the credit of loan companies from all aspects of the supply chain, but also the availability, convenience, and precision of resources flexibly meet the loan quota and financing term requirements of underfunded enterprises.

Technology empowerment

The value of B2B e-commerce platform is mainly reflected in the integration of business transaction information for financial institutions, the establishment of a more accurate and efficient information sharing platform, the optimization of the platform

itself and the excavation of better customer service (Li & Ma, 2011). The application of blockchain technology can reduce the financial cost and risk of supply chain, expand the service of supply chain finance (Zheng, 2019), and the Internet of things technology can prevent the risk of repeated pledge of movable property (Jiang & Wang, 2019). Therefore, B2B e-commerce platform should pay attention to the penetration application of technology, use digital technology to efficiently collect, analyze and process data and information, establish an open and complete service platform, and ensure a higher supply chain system efficiency, high performance, high expansion and high security. Through the technical cooperation among the main bodies, we can solve the problem of capital shortage of financing enterprises, develop more new customers for the platform, and improve new profit sources and market segments.

Win-win for participants

As a typical benefit-driven virtual organization model, common interests of supply chain finance mainly due to the reduction of the supply chain's comprehensive financial costs and the stability of supply chain operations brought about by liquidity supplements, and new business profits derived from it (Dou, Bai, & Wu, 2014). Win-win for participants is the ultimate goal of B2B supply chain finance. To achieve a win-win situation for the main body, we need to rely on the coordination of "four flows", credit promotion and technology empowerment. We need to overcome the possible low efficiency caused by the imbalance of power allocation, guard against various opportunism and moral risks, and put an end to the unfair distribution of the main body's interests. Therefore, with the support of information technology, the participants of supply chain must build a high-level information sharing center, a cooperative culture with the highest reputation and a fair and just benefit distribution mechanism to achieve a win-win situation for the participants, and finally promote the sound cycle of supply chain finance ecology.

RISK ANALYSIS OF B2B SUPPLY CHAIN FINANCE

In theory, B2B supply chain finance will achieve win-win cooperation between e-commerce platform and all participants by means of "four flows" coordination, credit enhancement and technology empowerment. However, because the development of B2B supply chain finance in China is still in its infancy, there are some constraints in practice, which increase its operational risk objectively. B2B supply chain finance is a highly comprehensive and high-tech financing mode. It pays more attention to the network structure of the supply chain organization, the supply chain transaction process and the management of the supply chain finance elements. It requires online, batch, efficient and timely credit and financial business processing. Therefore, it puts forward very high requirements for the risk control level of e-commerce platform. Supply chain finance operation risk includes external environment risk, supply chain network risk and supply chain enterprise risk (Jüttner, Peck, & Christopher, 2003).

Exogenous Risk

Exogenous risk, also known as environmental risk, refers to the risk that comes from the outside of the platform and cannot be controlled and managed by the supply chain finance platform, including the risk caused by irresistible factors such as macroeconomic environment, industry environment, legal environment, etc.

Economic and environmental risks

The factors of economic environment mainly include cyclical fluctuation and policy adjustment. The instability of economic activities will affect the survival and development of industry, and then threaten the stability and security of supply chain finance ecology. For example, the decline of steel trade market in the past few years has brought adverse effects on the industry's supply chain finance activities. Most of the service subjects of B2B supply chain finance are small and medium-sized enterprises, whose risk resistance ability is weak, and their profitability tends to fluctuate with the change of macroeconomic environment. At the same time, the government's restrictive policies on the industry will also directly affect the profitability of the industry, further affect the loan direction of banks, and bring credit constraints to platform enterprises.

Industry environmental risk

The development stage of the industry, the competitiveness of the industry and the external support to the industry will affect the decision-making of the B2B supply chain finance participants. For example, industries such as artificial intelligence and new materials are in the early stage of growth, with fast growth speed and large space, but enterprises in this stage of development are prone to face problems such as unstable business conditions and insufficient cash flow; while enterprises in the mature stage, with slow growth speed and small development space, have the advantages of stable business conditions and stable capital flow. Industry competitiveness or competition intensity will also affect the operation and profitability of the industry. There are many competitors in the industry with fierce competition, which means that there are many homogeneous products, such as the Internet, FMCG and other industries. Therefore, B2B supply chain finance business should correctly choose industries with stable environment and avoid industry risks.

Legal environment risk

Legal environment risk is an important aspect that restricts the development of B2B supply chain finance. First of all, China's legislation on future property security is still blank. Most of the B2B supply chain finance models are guaranteed in the form of property option certificate, not real right certificate, but credit guarantee in essence. If one party of the supply chain loses future property due to breach of contract, it will cause credit loss and legal risk (Craighead *et al.*, 2007). Secondly, there is no clear law on B2B supply chain compensation in China. In the field of finance, the transfer and circulation of e-warehouse

receipts are regulated specifically, but in practice, the transfer and circulation of e-warehouse receipts are very frequent and lack of applicable legal basis; in addition, B2B platforms in China rely more on industry autonomy, lack of relevant legal supervision, and the abuse of information by platforms to obtain interests and infringe the rights and interests of other subjects often occur.

Endogenous Risk

Endogenous risk refers to the risk from the enterprise or supply chain network. At present, there are many researches on credit risk and operational risk. Combined with the characteristics of B2B supply chain finance, we mainly focus on structural risk, capital risk, technical risk and pledge risk in this section.

Structural risk

The structural design of supply chain will affect the efficiency and effect of risk management. The number of nodes and connection mode of enterprises in the supply chain may be affected by the decision-making of any node enterprise [8]. Except for a few large-scale e-commerce giants such as Alibaba and Jingdong, most e-commerce platforms do not have supporting warehousing logistics, loose management of cluster chain, industrial chain and service chain, and do not have strong enough control power. The financial risk control of the platform is realized only with the help of big data technology, and the risk control of supply chain network is obviously insufficient. In essence, the supply chain is different from the virtual organization of enterprise management. The limited rationality and potential opportunistic behavior of trading partners increase the complexity of economic activities. The poor spirit of node enterprise contract and the collective collusion of borrowers will lead to supply chain finance risks. Therefore, the common obstacle for e-commerce enterprises to develop supply chain finance is to restrict the risk control ability from structure layer in China.

Fund-side risk

Due to the deterioration of the situation of B2B supply chain finance, the failure of supply chain operation to achieve the expected goal will lead to funding risk, which mainly includes the shortage of sources of fund, the disorder of funding investment and the poor recovery of funding. Under the B2B supply chain finance model, e-commerce platforms dominate financial services, and funds are raised from three sources: one is from the platform's own funds; the other is from commercial banks; the third is from informal financial channels such as P2P companies and private lending funds. Among the above three sources, in addition to the internal funds of e-commerce enterprises, the cost of funds of commercial banks is usually lower than the cost of funds of informal financial channels. However, due to the weak risk control system or the lack of credibility of e-commerce companies, the platform has a very limited amount of funds from formal financial institutions. At present, most of the B2B supply chain finance platforms mainly rely on the platform's own funds, especially in the early stage of the establishment of the platform, banks and other financial institutions have weak willingness to invest in the platform, and the source of funds is limited, which cannot guarantee the fund demand of platform enterprises. In order to meet the business needs, the platform will import funds from non-governmental organizations, but the leverage of such funds is too high, which is easy to cause financial risks. The lack of evaluation and supervision of the platform for enterprises leads to the node enterprises with high risk of capital flow, and the enterprises use loans to invest in projects with high risk. These disordered capital investment problems will bring potential risks to the platform. Finally, the poor operation and lack of credit of the platform enterprises will also lead to the risk of capital recovery, which is the top priority of B2B supply chain finance capital risk prevention.

Technical risks

The operation of B2B supply chain finance needs to rely on the support of new generation technologies such as the Internet of things, cloud computing, blockchain and artificial intelligence. However, at this stage, the application of B2B supply chain finance technology lags behind the market demand, mainly for lack of understanding of technology application, lack of investment in technical facilities, lack of technical human resources, etc. Insufficient application of technology is easy to cause information sharing failure or external attack of platform system, which leads to the security of online transaction settlement and payment. Lack of corresponding technical support or insufficient technical support will lead to failure of business flow, information flow, logistics, and capital flow sharing in the supply chain system structure, making it possible to achieve supplier and logistics through horizontal cluster chain, vertical value chain, and intermediate service chain management. It is difficult to effectively connect the various nodes of merchants, distributors, banks, customs and consumers, making it difficult to extend the management of various functions of a traditional single enterprise to the strategic integration of systems across the entire supply chain. In addition, it is worth noting that the lack of effectiveness of the "four flows and one" is easy to increase the business cost of B2B supply chain finance operations on the one hand, and it is prominently reflected by the increase in information acquisition costs and human resources costs; on the other hand, it is easy to increase Credit risk and information transmission risk of B2B supply chain finance operation. The defects of technology application will also lead to process risks of B2B supply chain finance, including application, review, credit extension and post loan management, such as multiple pledge of inventory in the process of financing application, collusion of both parties in the transaction to defraud loans and other behavioral risks, non-compliance of employee project review exposed in the review stage, hacker attack on electronic orders, inaccurate and overestimated false electronic orders or models occurred in the credit stage Credit line, inaccurate analysis of big data in post loan management stage, failure of Internet of Things monitoring, insufficient application of blockchain and other judgment errors. Technology risk will bring negative impact on the operation effect and efficiency of B2B supply chain finance.

Risk of pledge

When an enterprise borrows money from a bank, if the credit level of the financing enterprise is lower than its borrowing amount, it is necessary to use the pledge as a risk compensation to the bank to increase credit for itself. Movable property or right pledge is an important part of supply chain finance activities, and is applied in many supply chain finance scenarios, such as the supply chain finance model based on advance receipts and the supply chain finance based on inventory pledge. With the innovation and development of supply chain finance, pledges have begun to expand from physical assets to intangible assets. Therefore, collateral risk is an important aspect of risk prevention in the B2B supply chain finance. From the perspective of the types of pledged goods, the high-tech products with fast technology upgrading bring great risks. The agricultural products, fresh and other pledged goods are more vulnerable to loss, poor stability, and greater risk of pledge, which requires the platform to carefully select the pledged goods. The evaluation of collateral value is easily influenced by evaluation methods, quality of evaluators, application of evaluation tools, which are all important sources of collateral risk. For example, improper selection of the subject matter in the market-based asset evaluation, excessive cost components in the cost-based asset evaluation, depreciation of the income-based asset evaluation, and lack of the ability of the appraisers to perform the duties will result in an objective valuation of the pledged property. When the market price of the pledge is unstable or even drops, the value of the pledge will decrease. This situation will directly affect the bank's lending quota and lead to risks such as pledged items.

PREVENTION AND CONTROL STRATEGY OF RISK IN B2B SUPPLY CHAIN FINANCE

In order to promote the efficient landing service of B2B supply chain finance to small and medium-sized enterprises, it is very urgent to put forward the prevention and control strategy for the above built-in and exogenous risks. The idea of risk prevention and control is shown in figure 3.

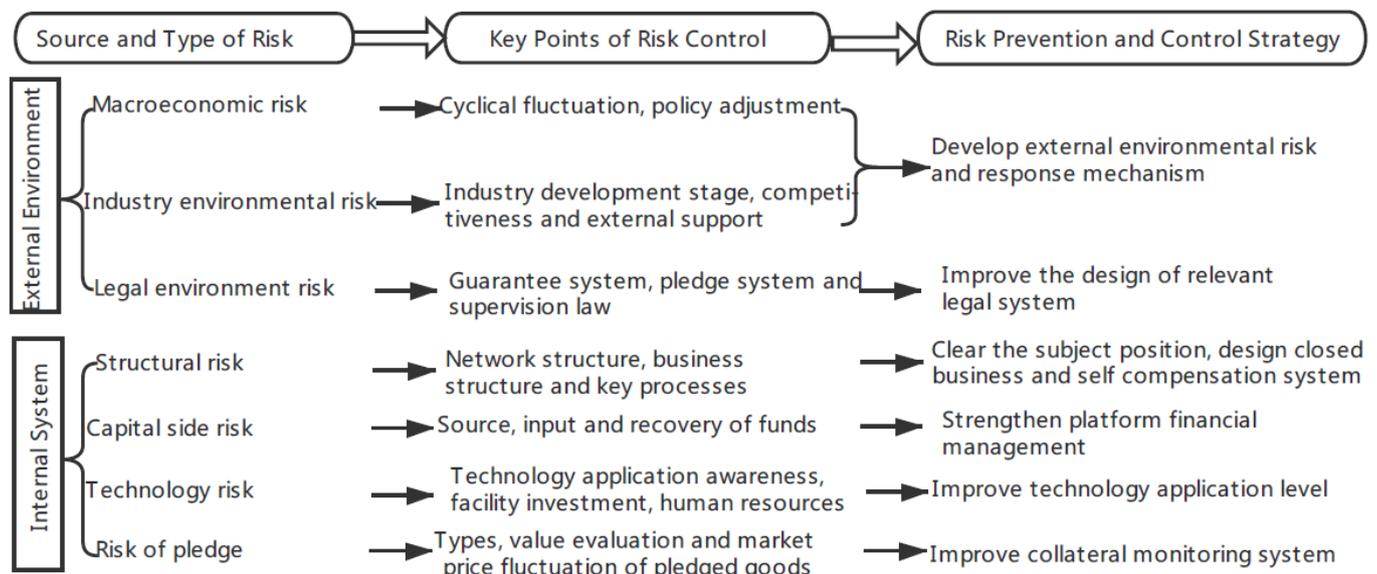


Figure 3: Risk prevention and control of B2B supply chain finance

Exogenous Risk Prevention And Control Strategy

Development of early warning and response mechanism for external environmental risks

The macroeconomic environment comes from the outside of the enterprise, and its changes will affect most industries. Each participant should construct and maintain a high sensitivity to the economic situation and industry situation, attach importance to the staff with strong risk awareness and risk response ability to act as risk early warning work, hire risk research experts to carry out technical analysis and prediction of risk, and arrange risk prevention and risk stop loss in time. At the same time, B2B supply chain finance platform management team should also have good sensitivity and ability to deal with environmental risks from economic and policy aspects, and formulate a good external environmental risk early warning and response mechanism, not only considering the operating conditions of the cooperative enterprises themselves, but also considering the development stage of the industry or whether it is a policy-supported industry, as well as the overall degree of competition of the industry. Make full use of all kinds of information sources to identify the cooperative objects, exclude the enterprises with great environmental risk, especially when the external environmental risk comes, we can take positive and effective response measures to prevent and control the risk loss.

Perfecting the design of relevant legal system

The complexity of B2B supply chain finance platform structure and the diversity of transaction business lead to the uncertainty of its applicable law, so it is necessary to design and perfect the relevant legal system from the top level. First of all, clear e-commerce platform access standards and related legal responsibilities. E-commerce platform is the leading organization of supply chain finance activities, which is directly related to the security and compliance of B2B supply chain finance platform.

It is suggested that the relevant provisions of financial products and services should be added to the early Electronic Commerce Law, and the relevant qualifications and operational requirements of e-commerce enterprises engaged in financial activities should be standardized from a legal point of view. Secondly, we should improve the guarantee laws and regulations. Pledge guarantee is the key to the development of supply chain finance activities. It is suggested that the guarantee Law should be amended and perfected to extend the scope of pledge from early inventory and accounts receivable to intangible assets such as intellectual property rights and carbon rights, so that supply chain finance can be carried out more widely; at the same time, the registration system of chattel pledge should be standardized to prevent the repeated pledge of the same asset to expand the financial risk multiplier, and the order of payment of floating mortgage should be made clear. Third, the establishment of regulatory coordination mechanism. B2B supply chain finance cross-regional, cross-industry characteristics, need different fields of regulatory agencies to coordinate with each other, curb all kinds of violations, and create a good legal environment for B2B supply chain finance.

Internal Risk Prevention And Control Strategy

Scientific design of business process and prevention of network structure risk

The dominant function of e-commerce enterprises determines their dominant position in the system operation, as well as their initiative and convenience in risk management and control at the structure level. Network structure and business structure are two aspects of supply chain finance structure dimension risk management (Song & Yang, 2018). The risk prevention of the network structure layer requires e-commerce enterprises to lay out the network status of the main participants in the supply chain, ensure that the roles of the main players and the division of labor are clear, and form a stable and effective supply chain finance ecosystem. E-commerce enterprises should also reasonably design the business structure, make each business link connect with each other, guard against all kinds of uncertainties and potential risks, and ensure the return of capital in the process of transferring value-added assets. The non-compliance of time and business flow, false information flow or unstable capital flow may lead to the fault and failure of platform transaction process, which brings huge risk to supply chain finance. In order to control the transaction process risk, e-commerce enterprises should design the supply chain transaction process into a complete closed self-compensation system, so that the transaction risk related to B2B supply chain finance closely matches the corresponding operation process and promote the benign operation of B2B supply chain finance through the coordination and cooperation of "four flows".

Strengthening the financial management of the platform and reducing the risk of capital flow

The capital flow risk related to B2B supply chain finance activities mainly includes financing risk, investment risk and capital recovery risk. The platform can cooperate with banks to develop new financial products according to the characteristics of enterprises and investment projects, try credit asset securitization financing, or introduce industrial capital. These financing channels have the characteristics of credit guarantee and promotion, and the cost of capital is relatively low, which can reduce the financing risk of the platform. For the prevention of investment risk, respectively from the pre-loan, loan and post-loan three stages of omni-directional monitoring. Before loan, carry out relevant research, understand the credit status, repayment ability and management level of loan enterprises, use digital technology to complete intelligent credit; make use of "four-rate" high-level information sharing platform to supervise and feedback in real time to ensure the compliance of funds; keep track after loan, and adjust the credit line according to the status of the enterprise and the implementation of the project. Finally, according to the self-compensation logic system, we design a closed capital return procedure, and ensure that the income of the loan enterprise repay the loan principal and interest through the intelligent contract, so as to effectively prevent the risk of capital recovery.

Improving the level of technology application and preventing the risk of technology

B2B supply chain finance platform should strengthen technical risk control from three aspects: platform operating system, key point design and establishment of risk database. Firstly, digital technology is fully introduced, data collection, information analysis, early warning prompt, emergency control and other core functional modules are fully introduced, the risk control system of platform operating system is constructed, B2B e-commerce trading system, payment system, logistics system and so on are monitored, and abnormal technical operations are searched and analyzed in time. Secondly, we should comprehensively improve the level of digital technology application at the industrial, financial and service end. We need to standardize the interface of each application end in the platform, make the transaction data information of different participating entities seamlessly connect, and shorten the reaction time of transaction entities in the supply chain flow process. With the advantages of information governance of big data, the visual characteristics of the Internet of Things technology, the de-intermediation of blockchain technology, and peer-to-peer transactions, we can prevent various risks arising from the structure layer, process layer and factor layer of the B2B supply chain finance, Technological innovation realizes the "four flows" effectively running through the horizontal cluster chain, vertical value chain, and each node and transaction process of the intermediate service chain, comprehensively improving the platform's overall risk prevention and control capabilities. Finally, big data, artificial intelligence and other technologies are used to construct the risk case base, collect and accumulate abnormal operation data, classify and collect them into the corresponding database, and match with the standard risk case database data, and constantly improve the risk prevention and emergency treatment plan.

Perfecting the monitoring system of collateral and controlling the risk of pledge

The pledge risk in B2B supply chain finance mainly comes from the choice of pledge variety, the fluctuation of pledge price and the evaluation of pledge value. The platform should improve the collateral monitoring system, be familiar with the

quantity, performance, quality and safekeeping scheme of all kinds of collateral of loan enterprises through big data technology, apply the Internet of things system to grasp the real-time dynamics of collateral, introduce blockchain technology, ensure the authenticity of advance collection and receivable creditor's rights through distributed ledgers, and understand the feasibility and security of intellectual property through big data technology Development prospects, screening out high-quality collateral. B2B e-commerce platform uses the visibility of Internet of things technology to modernize the data line of movable property guarantee, monitor the price change of movable property pledge in real time, and dock with the goods in the field of commodity circulation to estimate the value of inventory pledge accurately. Financial institutions obtain collateral data information through information sharing platform and make accurate credit decisions.

CONCLUSIONS AND IMPLICATIONS

In summary, we analyzed the status and functions of B2B e-commerce platform, supply chain enterprises and service providers in B2B supply chain finance, and proposed that B2B supply chain finance logistics, business flow, information flow and capital flow coordination, supply chain enterprises relying on the credit advantages of B2B platform to obtain credit enhancement, application of digital technology and win-win cooperation of supply chain participants are good for B2B supply chain finance Key elements of sexual operation. This paper also analyzes the external environment risk, capital risk, technology risk and pledge risk of B2B supply chain finance operation from the two perspectives of external environment and internal system of supply chain and puts forward risk prevention and control strategies according to the corresponding key points of risk control. The research puts forward governance strategies such as formulating external environmental risk early warning and response mechanism, improving relevant legal system design, strengthening platform financial management, improving technology application level and improving collateral supervision system, which provides reference for the healthy development of B2B supply chain finance in China.

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Research on the influencing factors in college students' entrepreneurship and innovation intention-base on the information exchange

(Full Paper)

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ABSTRACT

This study will explore the influence factors of college students' innovation intention, the previous research mainly focus on self-efficacy and motivation, social capital for the influence of innovation intention, this research will be based on the previous research, put forward a new independent variable, to explore the effects of education, social capital, past experiences and peer relationship on information exposure, information sharing and pioneering consciousness. One of the innovation points of this study is to propose the influence of college students' peer relationship on information exposure and information sharing in entrepreneurship. Based on Self-determination Theory (SDT) and Conservation of Resources Theory (COR), students in universities were selected as the respondents. Empirical analysis was conducted by questionnaire, and PLS was used to test SEM to reach the final conclusion. The results show that university peer influence (close friends) is positively correlated with information exposure, information sharing and entrepreneurial intention. This study maintains that college students' education, social capital, previous experience and peer relationship are positively correlated with entrepreneurial intention, and these variables can also influence information exposure and information sharing. This study will be able to effectively improve the influence of university peer relationship, information exposure and information sharing in university entrepreneurship, and fill in the theoretical gaps of innovation and entrepreneurship papers. The relevant theoretical research in this paper will be effectively applied to universities. Through adjusting university peer relationship, information exposure and information sharing, it will better help college students form entrepreneurial intention.

Keywords: entrepreneurship, innovation, information exposure, information sharing.

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INTRODUCTION

Entrepreneurship and innovation have been widely concerned as a hot issue in society. With policy support and government promotion, an increasing number of outstanding entrepreneurial enterprises have emerged in many frontier areas of innovation and entrepreneurship. In these vital regions, it is of significance to promote entrepreneurship and innovation and attract more young people to join the group. Confronted with this, this study aims to create an environment suitable for innovation and entrepreneurship by probing into the factors affecting entrepreneurship and innovation intention of college students.

This study is based on the theoretical support of Self-determination Theory (SDT) and Conservation of Resources Theory (COR). SDT mainly includes competence, relatedness, and autonomy. Relatedness among SDT will be used as students' social relationships (Marylene & Edward, 2010). In terms of COR theory, a contributing factor in resource decrease is the increase of ambient pressure, which is measured from the specific environment rather than just the internal emotions of individuals (Stevan, 2001). Therefore, in fierce employment competition, the inner pressure of potential entrepreneurs and the attitude of others, such as relationship network, will have an impact on the final entrepreneurial idea.

The entrepreneurial attitude of students will change with the external environment, most important of which is entrepreneurial attitude (Christian & Nikolaus, 2003). In previous studies, Phillip et al. (2002) took the background composed of family environment, business environment, gender and education level as variables, and this study made appropriate adjustments based on reality.

Among independent variables, previous research results indicate that perceived university support can support college students' entrepreneurial ideas (Saadat & Shumaila, 2015). Hence, a good university entrepreneurial environment will positively adjust the relationship between entrepreneurial intention and entrepreneurial activity scope (Galina, Oleksiy & Karina, 2006).

In the meantime, relevant research figures out that social capital has a major impact on entrepreneurship and innovation (Hockerts 2015). For potential entrepreneurs, previous work experience is an important factor affecting entrepreneurship (Kim et al., 2006). Therefore, previous experience is added as a new factor in this study.

Furthermore, in previous studies, peer influence has often been used in online communities and consumption, which often refers to the close friends. Their daily behaviors and attitudes will have an impact on our social networks (Ravi & Akhmed, 2015). No previous direct research has linked college students' peer influence with entrepreneurial awareness, which is the main purpose and innovation of this study.

This study selects information exposure and information sharing as dependent variables. Based on knowledge community networks, many knowledge contributors are able to bring value and competitive advantages to related production by sharing knowledge and providing information (Wang et al., 2016). It is found that the information required by users can affect their personal entrepreneurial action (Autio et al., 2013). Information exposure in social knowledge communities positively impacts potential entrepreneurs, and information sharing can promote relevant knowledge dissemination. Therefore, this study will combine the exposure and dissemination of information in the information network of college students with entrepreneurial intention.

In a nutshell, previous studies have formed a relatively complete system. However, with the increasing influence of social media on college students, there is lack of peer relationships and information exposure in social networks. Meanwhile, in entrepreneurship and innovation, there is no special research on peer influence and information network of college students. Therefore, this study added social factors based on previous literature results to explore the influence of information exposure, information sharing and peer relationship and fill in the research gap.

The structure of this paper is as follows. The following section is the literature review, which variable factor will be further introduced in detail later with relevant supporting literature discussed. Then, conceptual model and research hypotheses are proposed and the findings and conclusions are drawn. At the end, results and discussion as well as the limitations and contributions of the study.

LITERATURE REVIEW

Entrepreneurial Intention (EI)

Entrepreneurship has been a prominent driving force of global economic growth. It represents an individual's commitment to starting a new business (Krueger & Carsrud, 1993). The practice of entrepreneurial behavior originates from entrepreneurial intention, which is crucial to the process of entrepreneurship as the first step. It determines the connection between thought and action and plays a positive role in guiding entrepreneurship. Therefore, this study will explore the main factors affecting college students' entrepreneurship and innovation intention.

Information Exposure (IE)

In the current context of interconnection, individuals' access to external information will affect the identification and evaluation of opportunities, and subsequently promote entrepreneurial ideas and activities (Erkko, 2013). Meanwhile, information exchange has a great influence on opportunity discovery. The exposure and sharing of online information can increase the individual's understanding of the information, and the increase in the frequency of information can also enhance the individual's trust. Current research has demonstrated that users' demand for information can affect their personal entrepreneurial action (Autio & Erkko et al., 2013). However, there is no research on specific knowledge construction network to the group of college students, so this study will focus on exploring the information exposure in universities and its influence on students' entrepreneurship and innovation intention.

Information Sharing (IS)

Entrepreneurs are able to share information about industry trends, and sharing information with each other helps identify opportunities (Briggs, 2009). Information sharing is based on information exposure, which is an important prerequisite for information sharing. Therefore, there is a close relationship between information sharing and entrepreneurial behavior. The previous concept of information sharing is rarely used in entrepreneurial intention, and this study will study the factors affecting information sharing.

Education (E)

University will provide students with some resources on the network of human relationships, the opportunities to improve students' ability to opportunity recognition (Wan et al., 2011). Studies have shown that if the university can provide financial assistance for the commercial projects of college students, it will increase the willingness of students to start their own businesses and thus increase the possibility of taking practical actions (Parker & Belghitar, 2006). In conclusion, the education provided by the school and the support provided by the school for students can promote the formation of students' entrepreneurial intention (Saadat Saeed et al., 2015).

Social Capital (SC)

Social capital is a potential resource, which connects the social network formed in the long term and provides a cohesive force to bring a group together (Portes, 1998). It is believed that the perceived possibility of social capital acquisition is positively correlated with social entrepreneurial intention (Kai, 2015). Therefore, social capital has a great influence on entrepreneurial intention (Linan & Santos, 2007). The social capital in this research mainly tends to support the spiritual support of potential

entrepreneurs from the interpersonal relationship around them and the sense of recognition that this person gets from the interpersonal network around them.

Prior Experience (PE)

Prior experience enables potential entrepreneurs to gain experience and enhance entrepreneurial skills (Brenner, Pringle & Greenhaus, 1991). Previous studies have shown that previous work experience is a predictor of entrepreneurial intention (Kautonen, Luoto & Tornikoski, 2010). If people worked in a small or new enterprise before, it can play a positive role in the willingness to start their own business (Zapkaua & Schwens, 2015). In previous studies, most of previous experience refers to the potential entrepreneurs to their experience through direct experience, this study explores personal previously direct experience and indirect experience is obtained by the practice of others.

University Peer Influence (UPI)

In marketing, word-of-mouth marketing of products reflects the role of peer relationship in product sales, and users with fewer friends are more susceptible to peer influence than their counterparts (Sinan & Dylan, 2010). Under the influence of peers, consumers are more likely to consume certain products (Ravi & Akhmed, 2015). In addition, the number and size of social networks can influence individuals' intentions. If a team member is willing to be guided by some advanced experience, he can influence other team members. Through this part of research, we can know that the peer relationship will have an impact on personal willingness, but there are few studies that link it with the entrepreneurial intention. In daily communication, the arrival of social network era makes the peer effect between the two more prominent. Therefore, in college, ideas and activities related to entrepreneurship can spread among peers (close friends and ordinary friends).

Research questions

Based on previous research on factors that influence college students' entrepreneurship, KC and UPI are not directly taken as variables affecting innovation and entrepreneurship intention, nor did previous research directly define IE as innovation intention. Therefore, we put forward that

1. What is the influence of education, social capital, university peer influence and prior influence on information exposure?
2. What is the influence of education, social capital, university peer influence and prior influence on information sharing?
3. What is the influence of education, social capital, university peer influence and prior influence on entrepreneurial intention?

CONCEPTUAL MODEL AND DEVELOPMENT OF HYPOTHESES

Research Hypotheses

In this paper, based on SDT and COR theory, the hypothesis model is proposed as shown in Figure 1. The relationship among education, university peer influence, social capital, prior influence on information exposure, information sharing and entrepreneurial intention is proposed with their influence studied. In view of the problems proposed in this paper, the assumptions of the model are as follows:

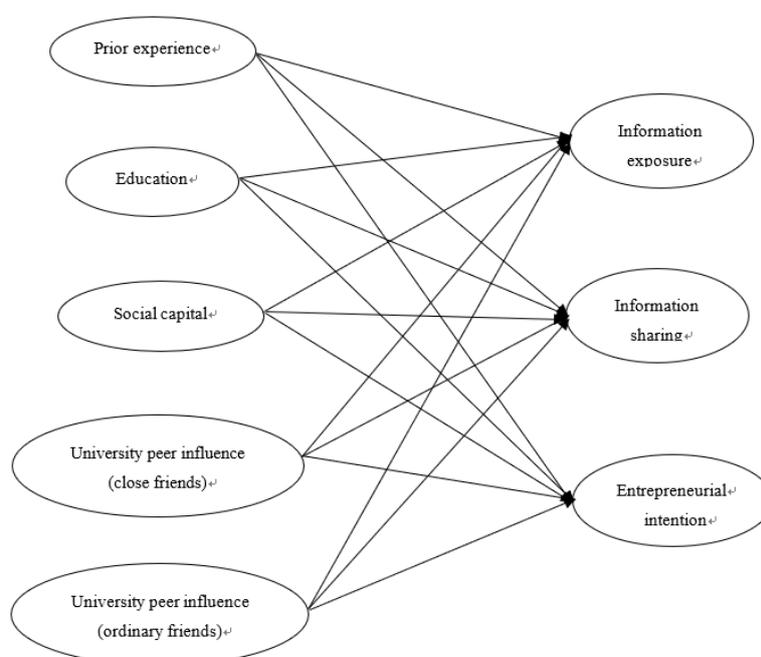


Figure 1: Structure model

Impacts of prior experience

For college students, the business plan project and implementation they participated in before help guide their subsequent entrepreneurial activities. With accumulated entrepreneurship plan and experience, students' innovative consciousness improves, which lays a foundation for future activities related to entrepreneurship. It is proved that there is a positive correlation between prior experience and entrepreneurial awareness. (Kautonen et al., 2013). Therefore, we propose the following hypotheses:

H1a: There is a positive correlation between college students' prior experience in innovation and the exposure of relevant information.

H1b: There is a positive correlation between college students' prior experience in innovation and the sharing of relevant information.

H1c: There is a positive correlation between college students' prior innovation experience and their entrepreneurship intention.

Impacts of education

Education plays an important role in cultivating students' consciousness and ideas. Universities can create an environment conducive to new ideas through curriculum, policy and funding. Previous literatures have done plenty of research in this part, and believe that there is a strong correlation between them. Thus, if a school is willing to provide financial support for students' entrepreneurial ideas, it can further promote entrepreneurial and innovative consciousness (Parker & Belghitar, 2006). Therefore, this paper proposes the following hypotheses:

H2a: There is a positive correlation between relevant innovation education received by college students and exposure of relevant entrepreneurship information.

H2b: Relevant innovation and entrepreneurship education received by college students is positively correlated with the sharing of relevant entrepreneurship information.

H2c: Relevant innovation and entrepreneurship education received by college students has a positive correlation with the generation of their innovation and entrepreneurship intention.

Impacts of social capital

Previous literature suggests that the perceived possibility of social capital acquisition is positively correlated with social entrepreneurial intention (Kai, 2015), and social capital is used as an external measurement factor. The social capital of this paper is more favored by family, friends and classmates as the main form of social support networks, with the spirit of encouragement emphasized. Therefore, we propose the following hypotheses:

H3a: The support of social capital is positively correlated with the exposure of relevant entrepreneurial information.

H3b: The support of social capital is positively correlated with the sharing of relevant entrepreneurial information.

H3c: The support of social capital is positively correlated with the generation of college students' innovation and entrepreneurship intention.

Impacts of university peer influence

The influence of college students' peer relationship on entrepreneurship and innovation intention is one of the innovative points in this paper. We make relevant assumptions on the influence of information flow among college students' peers and the generation of college students' entrepreneurship and innovation intention. Previous studies in other fields have shown that peer opinions can have a greater effect on individuals' purchase intentions and actions in consumption shopping (Ravi & Akhmed, 2015). At the same time, word-of-mouth sales in marketing also adopt this to increase sales (Sinan & Dylan, 2010). On this basis, this paper proposes:

H4a: The influence of college peer relationship (close friends) is positively correlated with the exposure of relevant entrepreneurship information.

H4b: The influence of college peer relationship (close friends) is positively correlated with the sharing of relevant entrepreneurial information.

H4c: The influence of college peer relationship (close friends) is positively correlated with the generation of college students' innovation and entrepreneurship intention.

H4d: The influence of college peer relationship (ordinary friends) is positively correlated with the exposure of relevant entrepreneurship information.

H4e: The influence of college peer relationship (ordinary friends) is positively correlated with the sharing of relevant entrepreneurial information.

H4f: The influence of college peer relationship (ordinary friends) is positively correlated with the generation of college students' innovation and entrepreneurship intention.

METHODOLOGY**Instrument**

Relevant questionnaires in view of the factors in Figure 1 were developed, and 5-point Likert scale (1= strongly disagree; 5 = strongly agree. The questionnaire is divided into two parts. One is the basic information of the respondents, and the other includes seven measurement variables, which are derived from the existing scale and prepared by ourselves.

There are questionnaires and scales about education. This paper is compiled according to the competitions, bonuses, policy support and entrepreneurial environment related to entrepreneurship and innovation in most universities. For peer relationship,

since there are few previous studies on peer influence in entrepreneurship and innovation, we prepare a questionnaire based on similar studies on peer influence. In social capital, SC1-SC8 mainly comes from Wasko & Faraj (2005). According to the scale of Faraj and Samer's (2005) questionnaire, since the social capital of this study is more inclined to the spiritual support of the people with close relationships around them, SC9-SC12 is also compiled according to reality. As there are few studies on information exposure in entrepreneurship and innovation, the relevant scales are mainly self-compiled. The information sharing scale comes from the study of Francesc et al. (2015) and the scale of previous experience selected relevant parts as well as entrepreneurial intention in the questionnaire of Liang et al. (2016).

Before data collection, a preliminary test was conducted on 10 volunteer college students to ensure the validity. This survey was conducted by offline paper questionnaires. Taking college students in Shenzhen as the main respondents, 300 questionnaires were sent out in Shenzhen and 287 valid data were obtained.

Data Analysis Method

In this paper, the least square method (PLS) was used to test the structural equation model (SEM), and the proposed research model was tested. Since PLS does not involve the assumption of population or score measurement, the selection of this method has advantages over other types of SEM. In addition, PLS can simultaneously estimate the relationship between the index load of the structure and the structure (Fornell & Bookstein, 1982). PLS extended principal component and canonical correlation analysis (Henseler & Sarstedt, 2013). PLS was constructed according to two sets of equations, including outer model and inner model. The former defines the relationship between potential variables and measurement indicators, while the latter defines the relationship between unobserved variables and potential indicators. The PLS method used in this study is through Smart PLS software.

Measurement Model Estimation

In the initial test, the results of eight variables (PE, E, SC, UPI(CF), UPI(OF), EI, IS, IE) were examined in a single dimension and in an external model. Values greater than 2/2 (or 0.707) are acceptable values for factor loading, and the community with variability explained by potential variables should be greater than 0.5 (Sanchez, 2013). By using the PLS method, the variables with low load and community are removed.

Single dimension of each of the three structures was checked by selecting alpha of Cronbach, rho, Composite reliability and AVE of dillon-goldstein. As shown in Table 1, the composite reliability of Cronbach's alpha and dillon-goldstein's rho are all higher than 0.70. Meanwhile, among all structures, AVE is above the minimum threshold of 0.50 (Fornell & Larcker, 1981). Therefore, the structures of the measurements used in this paper are all valid.

Table 1: Unidimensionality of constructs

Latent variable	MVs	Cronbach's alpha	Dillon-Goldstein's rho	Composite reliability	AVE
Entrepreneurial intention	4	0.86	0.87	0.90	0.70
Information exposure	3	0.82	0.85	0.89	0.74
Information sharing	3	0.87	0.88	0.92	0.80
Education	4	0.87	0.88	0.91	0.72
Social capital	3	0.83	0.83	0.90	0.75
University peer influence (CF)	3	0.88	0.88	0.92	0.80
University peer influence (OF)	3	0.88	0.89	0.93	0.81
Prior experience	5	0.87	0.88	0.90	0.65

Based on the estimated results of the model, the measurement load, external weight and public measurement were used to further evaluate the seven structures (Table 2). When the item is loaded on its correlation factor (loading > 0.50), the convergent validity can be proved. Individual reflection measurements can be considered reliable if they are more than 0.70 relative to the structure they want to measure. Therefore, we believe that the factor loads and communities shown in Table 3 are acceptable in this study.

To evaluate the effectiveness of the model. First, check the cross load of the building body and measurement. Secondly, the correlation between the square root of each subject AVE and other subjects in the model is compared (Chin, 1998; Fornell & Larcker, 1981). The results show that all relationships in the model meet the validity conditions (see Table 3).

Table 2: The outer model estimation

Latent variable	Manifest Variable	Outer weight	Factor loadings	Communality
Entrepreneurial intention (EI)	EI1	0.33	0.82	0.642
	EI2	0.22	0.78	0.714
	EI3	0.33	0.88	0.782
	EI4	0.32	0.87	0.716
Information exposure (IE)	IE1	0.45	0.87	0.721
	IE2	0.29	0.81	0.786
	IE3	0.42	0.89	0.767
Information sharing (IS)	IS2	0.37	0.89	0.794
	IS3	0.41	0.93	0.836
	IS4	0.35	0.86	0.753
Education (E)	E1	0.26	0.83	0.725
	E2	0.30	0.87	0.766
	E3	0.32	0.88	0.761
	E4	0.29	0.82	0.666
Social capital (SC)	SC9	0.39	0.87	0.750
	SC10	0.38	0.89	0.809
	SC11	0.39	0.84	0.701
University peer influence (UPI-CF)	UPI 1	0.38	0.92	0.721
	UPI 2	0.35	0.91	0.704
	UPI 3	0.39	0.85	0.663
University peer influence (UPI-OF)	UPI 4	0.39	0.93	0.803
	UPI 5	0.38	0.93	0.786
	UPI 6	0.34	0.84	0.622
prior experience (PE)	PE 1	0.22	0.83	0.763
	PE 2	0.25	0.80	0.665
	PE 4	0.29	0.83	0.661
	PE 5	0.27	0.89	0.790
	PE 6	0.21	0.68	0.509

Table 3: Correlation between constructs

	E	EI	IE	IS	SC	UPI-CF	UPI-OF	PE
Education	0.85							
Entrepreneurial intention	-0.03	0.84						
Information exposure	0.31	0.26	0.86					
Information sharing	0.23	0.25	0.34	0.89				
Social capital	0.30	0.35	0.23	0.32	0.87			
University peer influence (CF)	0.35	0.42	0.44	0.30	0.34	0.90		
University peer influence (OF)	0.32	0.28	0.36	0.31	0.33	0.72	0.90	
prior experience	0.01	0.51	0.35	0.37	0.22	0.44	0.39	0.81

Note: The boldface figures in the diagonal represent the square root of the AVE figures. They should be higher than the correlation figures.

Results

Student demographics

A total of 300 students participated in the questionnaire and provided 287 valid questionnaires. The number of men and women in the questionnaire is balanced. The respondents come from more than 20 different majors, and the proportion of arts and sciences is relatively average. More details are shown in Table 4.

First, ANOVA analysis was conducted to study the influence of students' gender, age, grade and major on the seven factors. Results showed that the basic information had no significant influence. Next, students from different grades and majors are regarded as a whole.

Table 4: Demographic details of respondents

Gender	Male	142
	Female	145
Age	18 or below	48
	19	52
	20	112
	21	55
	Above 22	19
Year	1st year	45
	2nd year	137
	3rd year	78
	4th year	27
collage	Management	73
	Economics	23
	Linguistic	20
	Philosophy	19
	Sociology	13
	Communications	16
	Biology	33
	Computer	61
	Mathematics	22
	Engineering	7
Subject	Arts	164
	Sciences	123

Overall statistical results

The mean score and standard deviation of the measurement items of education (E), previous experience (PI), entrepreneurial intention (EI), information sharing (IS), information exposure (IE) and entrepreneurial intention (EI) are shown in Table 5. Among them, the average score of information exposure and education is the highest, indicating that these two factors have a great impact on college students' entrepreneurial intention.

Table 5: Overall statistical results

	Mean Score	S.D.
Entrepreneurial intention	2.56	1.029
Information exposure	3.15	0.898
Information sharing	3.02	0.973
Education	3.83	0.762
Social capital	3.03	0.670
University peer influence (CF)	2.58	1.027
University peer influence (OF)	2.73	1.050

PLS modeling results

PLS modeling was performed on the sample. The relationship between college students' entrepreneurial innovation intention and its influencing factors is shown in Figure 2.

Specific numerical values show that all path coefficients in the model are positive. The direct and indirect relationships are tested using the structural model, and the results are shown in Table 6.

This research through the use of standardized residual root mean square (SRMR) and the fitting of the model of a square method to evaluate (χ^2 / df). If the SRMR value is less than 0.10 or 0.08, the model is considered to have a good suitability (Hair et al., 2017). When the sample size is greater than 200, if χ^2 / df less than 5 greater than 2, is that the modeling results are satisfied (Hafiz & Shaari, 2013).

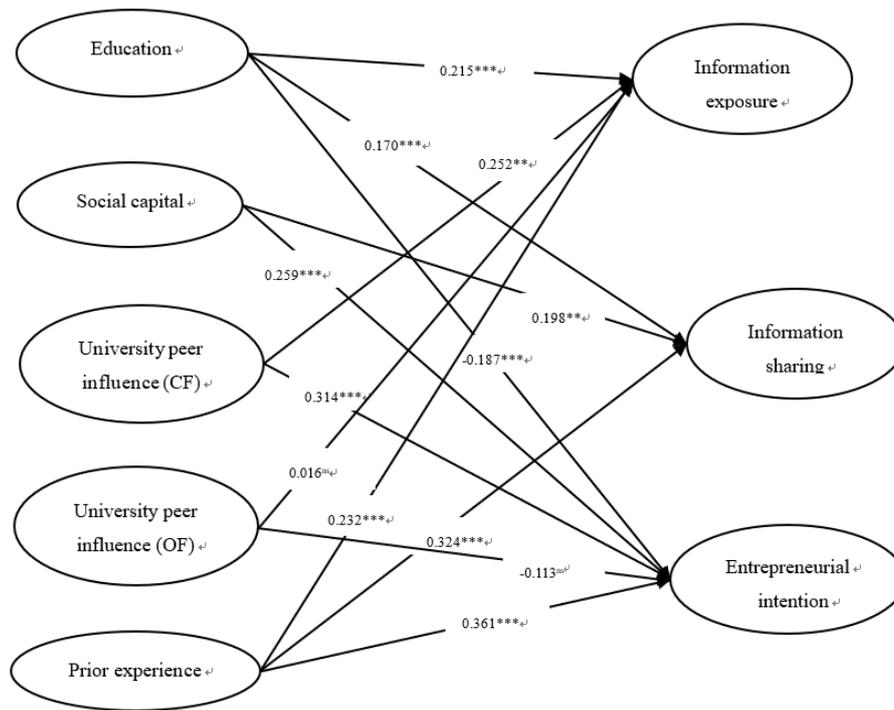


Figure 2: Result model

Table 6: Structural model path coefficients

	Information exposure	Information sharing	Entrepreneurial intention
Education	0.215***	0.170***	-0.187***
Social capital		0.198**	0.259***
University peer influence (CF)	0.252**	0.314***	0.314***
University peer influence (OF)	0.016 ^{ns}	0.232***	-0.113 ^{ns}
prior experience	0.361***	0.324***	0.361***

*** p<0.001, ** p<0.010, *p<0.050, ns = not significant

Justification of the Hypotheses

The following table presents the statistical test results of the final hypothesis relationship

Table 7: Hypotheses' results

Hypotheses	Results	Hypotheses	Results
H1a	Support	H3b	Support
H1b	Support	H3c	Support
H1c	Support	H4a	Support
H2a.	Support	H4c	Support
H2b	Support	H4d	Not Support
H2c	Support	H4f	Not Support

DISCUSSION

On entrepreneurial innovation, studies have shown that related education support university can give students a good atmosphere and stimulate students' entrepreneurial innovation (Luke & Jason, 2011). This study verifies the correlation between entrepreneurship education and innovation. We take the school competition, monetary prize, policy support and innovation climate into consideration, combining the schools' specific support measures of entrepreneurial innovation. The positive correlation between education and entrepreneurial as well as innovative intention is obtained. Also, education environment impacts information exposure and information sharing. If schools can provide entrepreneurial atmosphere, the infiltration and transmission of business information on campus can not only be spread through propaganda leaflets, but the network of information announcement, such as WeChat, Weibo and other social software. Furthermore, if students are close friends, information related to entrepreneurship and innovation is likely to be spread and shared.

The positive correlation between social capital and innovation intention has been demonstrated. This study proves the point again. But the former social capital refers to the broad social relations of financial support (Liao & Welsch, 2003), and the social capital of the present study more biased towards the people around us or potential entrepreneurs psychological support for entrepreneurs. In addition, this study sheds light on that financial and psychological social capital can motivate potential entrepreneurs and generate entrepreneurial intention. Furthermore, social capital can promote information sharing. When people backed for entrepreneurs in his heart, they will be willing to accept the information related to entrepreneurship. After that, they tend to share the information to the potential entrepreneurs around. The entrepreneurs can also give information after getting positive feedback to impel the sharing of information between both sides.

The prior experience of entrepreneurs can also promote the generation of entrepreneurship and innovation intention, which has been fully proved in many previous studies (Steven et al., 2011). We verify the correlation between the two on this basis and prove the positive correlation between previous entrepreneurial experience and information exposure as well as information sharing. When a potential entrepreneur has contacted related business projects or those around them, he is likely to become a potential entrepreneur by his own experience and indirect experience. As an entrepreneurial potential disseminator of information, he would increase the information exposure and share related information to surrounding people.

The influence of peer relationship on personal consumption is well reflected in the behavior of consumption. It is proved that the influence of peer relationship can drive purchase (Lewis et al., 2012). When a close friend is very satisfied with a product, the person may introduce the product to his friends, thus increasing the product exposure, and the party tends to buy the product. Therefore, we extend the idea to college students' entrepreneurial innovation intention. For one thing, the interpersonal relationship between college students helps transfer information. For another, along with information in multi-channel transmission, information credibility has also improved. The information receivers produce their own intentions about entrepreneurial innovation. The results point out that the influence of peer relationship among college students (close friends) is positively correlated with information exposure, and peer relationship can promote entrepreneurial intention.

CONCLUSIONS AND FUTURE STUDY

In this study, we explore the influencing factors in college students' entrepreneurship and innovation with their influence on information exposure and information sharing also measured. The results show that E and PI have direct influence on EI, IS and IE. Therefore, colleges need to promote entrepreneurship courses and provide an innovative atmosphere. Meanwhile, students should take the initiative to participate in relevant activities.

In addition, a structural model also suggests that SC to the EI and IS, social capital tend to get emotional support from people around. As a consequence, it is important to get enough spiritual support to cultivate an entrepreneur. With entrepreneurial intention, people may need more potential entrepreneurs to encourage and support.

Peer relationship of college students (close friends) can directly influence IE and EI. Information exchange among close friends is important for their behavior. This can explain that the information sharing between close friends increase information exposure through word of mouth, along with further information disclosure. The degree that students are familiar with the information also increases. It achieves individual entrepreneurial intentions ultimately promote their entrepreneurial ideas. Therefore, the information transmission among students should not be ignored.

Limitations of study

The questionnaire was collected in Shenzhen University. City difference may lead to college students discrepancy from various regions and the sample size of the survey is not large enough. However, in order to obtain more accurate measurement results, this paper questionnaire was sent randomly, covering a wide range of majors. The number of students majoring in arts and science with an average number of genders, so it could achieve a relative accuracy.

Contributions

The results of this study show that there are several different factors affecting the entrepreneurial and innovative consciousness. Apart from exploring their influence, we find that these factors can also promote the exposure and sharing of relevant entrepreneurial information. Moreover, based on previous research and information transmission changes, this study innovatively proposes the influence of peer relationship on entrepreneurship and innovation intention of college students. We apply peer influence to entrepreneurship and innovation intention of college students while there is no relevant research combing these two factors, and found the information sharing between close friends will increase information exposure than ordinary friends. Last but not least, this study explores the reasons affecting information exposure and information sharing from a new perspective, relevant research results will be combined with practice and applied to the universities, and then puts this definition to study information exposure and information sharing in entrepreneurship and innovation. In this way, it can help college students form entrepreneurial consciousness and carry out entrepreneurial activities in the future.

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APPENDIX : Questionnaire

Dimension	Scope	Questionnaire	Reference
Education	E1-E4	E1: I think there are a lot of innovation and entrepreneurship competitions E2: I think the school set up a lot of prizes for entrepreneurship and innovation programs E3: I think the university has many policies to encourage entrepreneurship and innovation E4: I think the school has a good environment of entrepreneurship and innovation on campus	
University Peer influence	UPI1-UPI6	UPI1: My close friends often talk about entrepreneurship UPI2: My close friends often spread the information about entrepreneurship UPI3: My close friends have started working on startups UPI4: My ordinary friends often talk about entrepreneurship UPI5: My ordinary friends often spread the word about entrepreneurship UPI6: My ordinary friends have started jobs related to entrepreneurship	
Social capital	SC1-SC8 SC9-SC12	SC1: I am able to gain respect from others through my daily interactions SC2: I like to help others SC3: I get satisfaction from helping others SC4: I was at the center of my social circle SC5: I know other people will help me, so it's fair to help others SC6: I believe that when I am in a similar situation, others will help me SC7: I feel that entrepreneurship can bring me satisfaction SC8: I think entrepreneurship can help others SC9: People around me often understand my entrepreneurial ideas SC10: People around me often support my idea SC11: People around me are willing to help me put my ideas into action SC12: People around me are willing to help me financially with my idea	Wasko, Lure, and Faraj. (2005)
Knowledge contribution Information exposure Information sharing	IE1-IE6	IE1: I can often see a lot of innovation and entrepreneurship information from social platforms IE2: I can get entrepreneurial opportunities from social platforms IE3: I can fully understand the development trend of innovation and entrepreneurship through social platforms IE4: I paid attention to social media operation accounts related to innovation and entrepreneurship IE5: I joined the online community related to innovation and entrepreneurship IE6: I joined the discussion group on innovation and entrepreneurship	

	IS1-IS5	IS1: I often share innovation and entrepreneurship information on social platforms IS2: I'm passionate about helping others on social media IS3: I tend to share information resources on social platforms IS4: Sharing information resources on social platforms can help others broaden their horizons IS5: I actively participate in the discussion of entrepreneurship and innovation on social platforms	Miralles, Francesc , Giones , and Riverola . (2016)
Prior experience	PE1-PE6	PE1: I have participated in entrepreneurship and innovation activities PE2: I know a lot of different entrepreneurial innovation organizations and activities PE3: I have some experience in organizing and leading teams PE4: I am familiar with the dynamics of social entrepreneurship and related policies PE5: I have practical experience in entrepreneurship and innovation PE6: I understand the complexity and difficulty of entrepreneurial and innovative activities	Chia, Ching, and Liang. (2016)
Entrepreneur intention	EI1-EI4	EI1: I have already had some preliminary ideas about the future entrepreneurship EI2: I would do anything to become an entrepreneur EI3: My short-term career goal is to develop entrepreneurial activities EI4: I'm determined to start a company in the future	Chia, Ching, and Liang. (2016) Liñán, Francisco, and Chen. (2010)

Research on the Innovative Application of Digital Supply Chain Finance in Private Science and Technology Enterprises in China

(Full Paper)

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ABSTRACT

Based on the comprehensive impact of digital technologies on supply chain finance in different application scenarios, we analyze operation procedures optimization and critical control points of four innovation modes about digital supply chain finance in private science and technology enterprises, which are digital supply chain finance model based on prepayment, digital supply chain finance model based on inventory pledge, digital supply chain finance model of based on accounts receivable and digital supply chain finance model of based on intellectual property pledge in this paper. At present, there are some problems in digital supply chain finance, such as weak risk control, inadequate technology application and imperfect legal system. In order to promote the efficient implementation of digital supply chain finance to private science and technology enterprises, the leading institutions of supply chain finance should attach importance to the governance strategies such as controlling the source of risk to avoid risk, accelerating the ecological innovation of digital technology enabling, and improving the legal system to regulate development.

Keywords: Digital technology, supply chain finance, private science and technology enterprises.

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INTRODUCTION

With the innovation and reform of digital technologies such as Internet, big data, cloud computing, artificial intelligence, etc., platform organizations based on new technologies continue to show the trend of integration and development with traditional industries, giving birth to new formats of digital economy (Zhang, 2019). The scale of digital economy was 31.3 trillion yuan, contributing 67.9% to GDP growth in China in 2018. The development of digital economy has accelerated the pace of transformation of new and old driving forces of private science and technology enterprises in China. In the first three quarters of 2019, the added value of high-tech manufacturing industry increased by 8.7% year-on-year, 3.1% faster than that of industries above designated size in China. China ranks 14th in the global innovation index. Private enterprises account for 83% of the high-tech enterprises in China. Private science and technology enterprises have become the main force and powerful economy supporting scientific and technological innovation in China. They have played an important role in improving China's source innovation and basic research ability. However, the inherent characteristics of light assets and high risk of private science and technology enterprises lead to serious financial exclusion (Xu & Wang, 2018). Although the balance of science and technology loans reached 328.3 billion yuan in China in 2018, it is far from meeting the financial needs of innovation investment of private science and technology enterprises. The problems of imperfect financial support mechanism, lack of capital investment subjects, insufficient policy coordination and imperfect intermediary service restrict the speed of innovation and development of private science and technology enterprises (Dou, Li, & Wu, 2014). At this stage, whether from the perspective of meeting the needs of innovation driven strategy, or from the perspective of building a modern industrial system of collaborative development of science and technology innovation and finance, it is of great significance to develop a new financing mode suitable for the development characteristics of private science and technology enterprises and provide high-quality financial support for their independent innovation.

Supply chain finance started at the beginning of this century in China. It has experienced the stage of supply chain finance 1.0 led by commercial banks and the stage of supply chain finance 2.0 led by industrial enterprises. With the intervention of Internet technology, it has developed to the stage of supply chain finance 3.0, contributing to easing the financial constraints of SMEs, including private science and technology enterprises. New digital economic model calls for new forms of financial services. Fintech is the product of the deep integration of finance and technology, and an important engine to drive the upgrading of modern financial industry. Driven by digital economy and financial technology, supply chain finance 4.0 (hereinafter referred to as "digital supply chain finance") based on digital technology has brought new opportunities for the financing needs of private science and technology enterprises. With the application of the new generation of digital technology, supply chain finance is not only the combination of industrial chain and finance, but also the deep integration of "digital technology + industrial ecology + modern finance". It will not only improve the availability, convenience and security of financial services for private science and technology enterprises, but also promote the precise services of supply chain finance for the high-quality development of private science and technology enterprises. Based on the analysis of the endowment

characteristics of digital supply chain finance, we discuss the operation process and critical point design of supply chain financial innovation mode in private science and technology enterprises from the perspective of digital technology penetration. Finally, we put forward corresponding governance strategies for the constraints that may exist in the actual application at this stage.

CHARACTERISTICS OF DIGITAL SUPPLY CHAIN FINANCE

Digital supply chain finance is the product of traditional supply chain finance embracing digital technology. As shown in figure 1, due to the application of big data, cloud computing, Internet of Things, blockchain and other technologies, digital supply chain finance presents a complex network structure, and the participants in the platform are infinitely expanded. The operation structure of upstream and downstream node enterprises in supply chain is no longer limited to the traditional chain organization, forming an energy coupling cluster network organization. The supporters of supply chain financial activities, such as government, financial institutions and logistics, also reflect the crisscross interest-related relationship, and expand more service channels through platform space. In the complex network system, the platform of supply chain finance plays the role of a neural hub and grasps the coordination of business flow, capital flow, logistics and information flow (hereinafter referred to as "four flows") in supply chain operation. It is familiar with the operation key points of supply chain system, and timely provides various supporting services including finance for the fund deficient enterprises in the platform. Therefore, the enterprises focus on the development of core competitiveness, which is conducive to the improvement of the competitive advantage of supply chain.

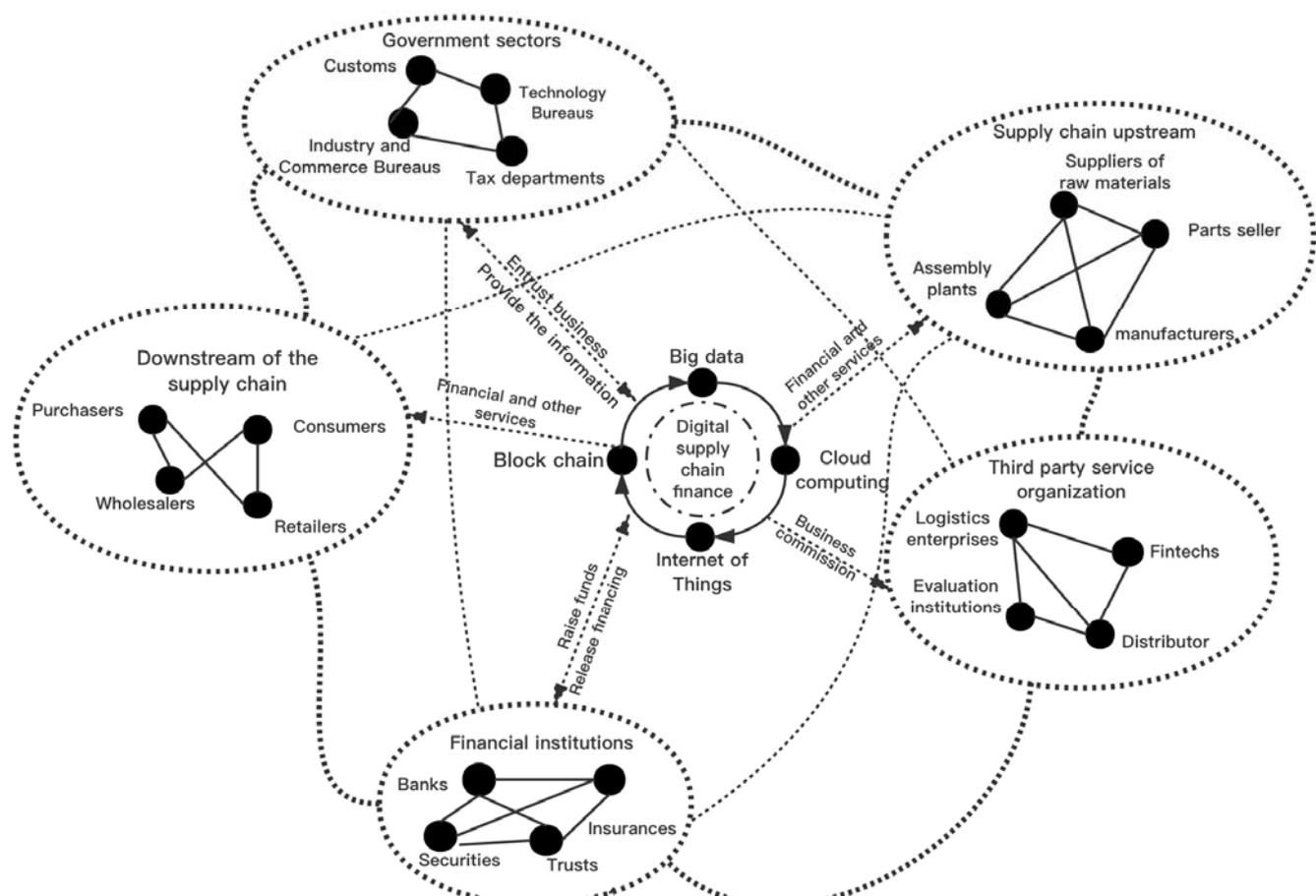


Figure 1: Complex network structure of digital supply chain finance

Driven by the convergence of digital technologies, supply chain finance has entered the era of innovation, transformation and upgrading. Compared with traditional supply chain finance, due to the innovation integration of digital technologies, digital supply chain finance presents the endowment characteristics of precision financing services, radiation credit enhancement and smart risk control, which can break through the bottleneck of high-quality development of traditional supply chain finance services for private science and technology enterprises in terms of service cost, operation efficiency, risk management and control, time and space span, etc. Thus, digital supply chain finance may provide diversified and personalized financial services for more and more private science and technology enterprises in supply chain finance ecosystem.

Precision Management Service

Traditional supply chain finance, which is dominated by labor and paper media, is difficult to realize transaction procedure control based on track management. It cannot accurately control the "four flows" matching degree, which limits the advantages of supply chain finance. The application of digital technology in the field of finance has given birth to a new business form of

digital Finance (He, 2019). The application of the Internet of Things and artificial intelligence can realize the full-process trajectory management of production, trade, and warehousing of technology-based enterprises, generate an intelligent monitoring network covering the entire chain and can feed back big data in real time, which can not only solve cargo control and warehouse receipt repetition Inventory supervision issues such as pledge and simultaneous supervision can also provide information support for financial institutions to accurately predict the funding needs of technology-based financing enterprises in all aspects. On the blockchain supply chain finance platform, each private science and technology enterprise can record transaction information in real time, and systematically complete the right confirmation of receivables or prepayments and the value management of all kinds of collaterals. Financial institutions provide and adjust credit lines for private science and technology enterprises through intelligent technical means. Private science and technology enterprises repay in time through intelligent contract. The whole process embodies "efficiency + saving + accuracy". With the improvement of digital technology, supply chain finance can better build a high-level data sharing center with the help of big data information depiction, visualization of Internet of Things technology, transparency of blockchain technology and other functions, and realizes the integrated management and monitoring of the whole chain information. This makes it possible to accurately position financing customers, accurately analyze customer financing needs and accurately provide customer financing solutions.

Network Credit Transmission

With the concept of "extension production" of all factors of supply chain industry, the interconnection of credit value has become the core issue of supply chain finance services (Shao, 2017). In the traditional supply chain finance services, the credit of the focus enterprises usually only covers the private science and technology suppliers or distributors of direct trade, which is difficult to be transferred to the upstream and downstream enterprises indirectly related. This kind of single-layer credit transmission can only solve one layer of financing problem, and limit the inclusive effect of supply chain finance, and restrict its effect of serving the innovation and development of private science and technology industry. In the digital supply chain finance, the new technology based on the Internet of Things and blockchain solves the problem of multi-level credit penetration, which makes the original strip credit transmission evolve into the network type credit transmission, and radiates the good credit of the focus enterprise to private science and technology enterprises that have direct or indirect transactions in the whole platform. These enterprises rely on the credit energy given by the focus enterprises to obtain financial resources to meet their capital needs in supply, production and sales. It is worth noting that the focus enterprise is the credit source of the whole supply chain finance ecosystem in the network credit transmission. Therefore, it is very important to set the access conditions of the focus enterprise. Besides, the digital technology is used to split the receivable creditor's rights and interests generated by credit sale, prepaid confirmation rights and interests based on the real trade information so that they can circulate among the platform enterprises, which is conducive to improving the efficiency and quality of credit transmission in the network platform.

Intelligent Risk Control

In supply chain finance system, we can obtain the transaction data verified by supply chain alliance enterprises with the help of Internet, cloud computing and big data technology. We can realize the real-time supervision of logistics dynamics, inventory value and goods warehouse receipt through Internet of Things, artificial intelligence and other technical means. The accelerated integration of blockchain encryption with cloud computing, Internet of Things, artificial intelligence and other technologies can prevent "duplicate or false warehouse receipts" and "self-insurance and self-financing" (Song & Chen, 2016) and other problems of loan fraud or fund arbitrage. Obviously, the use of digital technology has greatly enhanced the control ability of the leading institutions of supply chain finance to all kinds of transactions at the platform structure level. The operation of supply chain finance involves prepayment, inventory, receivables, all kinds of intellectual property rights and other asset elements as well as guarantee, mortgage, asset evaluation and other service elements of private science and technology enterprises. These elements not only relate to the risk source of supply chain finance, but also affect the key control points of risk management. Driven by the real business of the supply chain, the digital intelligent contract generated according to the transactions of each participant in the industry chain, cluster chain and service chain can not only prevent the moral hazard and speculation of the participants, but also realize the comprehensive evaluation of the asset mortgage or debt structure among the alliance enterprises in the platform. The intelligent design of closed self-compensation mechanism can better prevent the risk of capital investment and return. In the mature stage of digital technology application, intelligent risk control can better prevent all kinds of risks arising from the structure layer and element layer of supply chain finance and improve the overall risk prevention and control ability of the platform.

INNOVATIVE APPLICATION OF DIGITAL SUPPLY CHAIN FINANCE IN PRIVATE SCIENCE AND TECHNOLOGY ENTERPRISES

Due to the application of digital technology, supply chain finance has undergone great changes in the functional design of real estate or intellectual property pledge value estimation, credit evaluation of participants and risk control of capital recovery. Therefore, based on the endowment characteristics of digital supply chain finance, we will discuss the innovative design of the operation process optimization and key point layout of private science and technology enterprises applying supply chain finance mode in different scenarios in this section.

Digital Supply Chain Finance Model Based on Prepayment

This financing mode mainly takes place in the purchasing process of private science and technology enterprises. It emphasizes that private science and technology enterprises sign a commitment buyback contract with upstream suppliers, and use the established warehouse confirmed by logistics enterprises designated by the platform to apply for loans from financial institutions and take the future sales revenue of private science and technology enterprises as the source of repayment. The specific business process is shown in Figure 2.

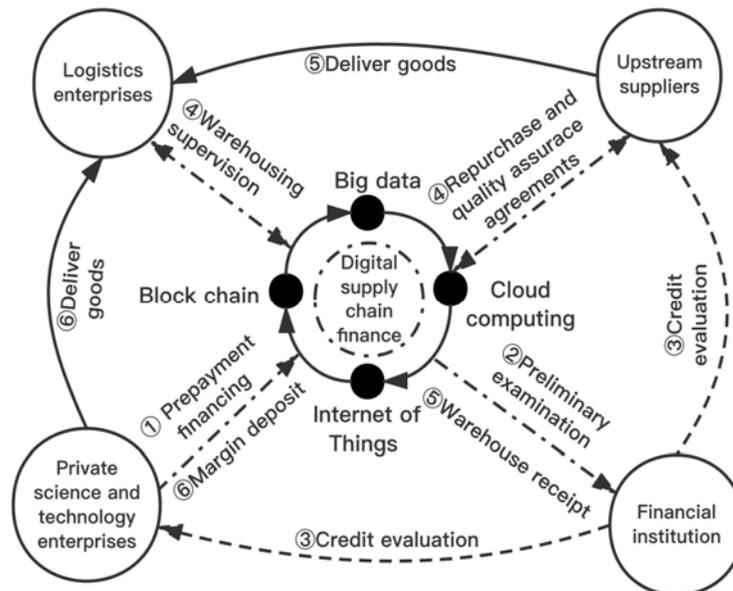


Figure 2: Technological process of digital supply chain finance model based on prepayment

- ① Private science and technology enterprises sign purchase and sale agreements with upstream suppliers, and apply for prepayment financing online accordingly;
- ② The platform captures the production and transaction scenarios of private science and technology enterprises and upstream suppliers through big data technology. It also extracts, integrates and analyzes transaction data and generates credit evaluation reports and delivers them to financial institutions with the help of cloud computing;
- ③ Financial institutions carry out multi-dimensional evaluation based on the offline credit situation of private science and technology enterprises;
- ④ The platform signs repurchase and quality assurance agreements with upstream suppliers and warehousing supervision agreements with logistics enterprises;
- ⑤ The platform informs the upstream supplier to deliver goods to the designated logistics enterprise warehouse. The logistics enterprise collects the goods information through the Internet of Things technology, generates the electronic warehouse receipt and shares it with the financial institutions in real time;
- ⑥ Private science and technology enterprises shall submit the deposit for taking goods. Financial institutions shall issue instructions to the logistics enterprises online to release the corresponding amount of goods taking right to the private science and technology enterprises.

According to the above process, committed buyback of upstream suppliers, supply of warehouse receipt pledge for logistics enterprises and repayment of private science and technology enterprises with future sales revenue are the key control points for the operation of digital supply chain finance model based on prepayment. In order to clarify the credit situation of upstream suppliers' commitment to buy back, we can trace the real trade activities between the main bodies of supply chain from the huge database, establish the coupling relationship, outline the panoramic image of upstream suppliers and conduct a comprehensive analysis by using the deep mining function of big data. Due to the application of electronic label technology in the Internet of Things, online and offline goods data docking, 24-hour intelligent warehouse management and remote positioning can be realized to ensure the security of pledged goods. Meanwhile, the comprehensive application of big data and cloud computing technology realizes the monitoring of the fluctuation of the commodity price of the pledge and provides convenience for financial institutions to adjust the credit line and interest rate. The intelligent contract is designed in strict self-compensation logic system to ensure that the sales revenue of private science and technology enterprises is used for repayment with the support of digital technology. This closed capital return program design of supply chain can prevent the risk of capital recovery.

Digital Supply Chain Finance Model Based on Inventory Pledge

This financing mode usually takes place in the production link of private science and technology enterprises with inventory pledge. It requires the use of Internet of Things, cloud computing and other technologies to carry out dynamic monitoring and value evaluation on the chattel pledge of private science and technology enterprises. Private science and technology enterprises

apply for loans from financial institutions with inventory as the pledge and take the capital inflow of future inventory sales as the source of repayment. The specific business process is shown in Figure 3.

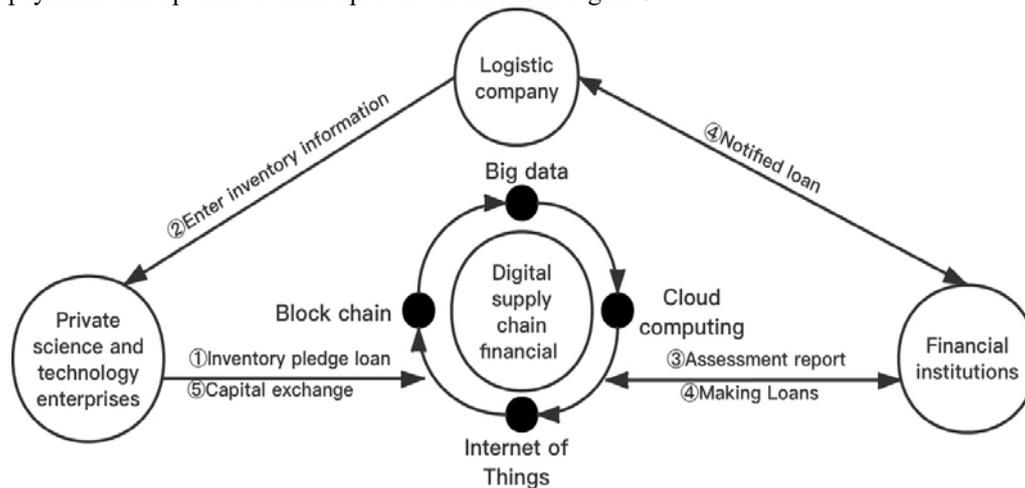


Figure 3: Technological process of digital supply chain finance model based on inventory pledge

- ① Private science and technology enterprises apply for inventory pledge loans online to supply chain finance platform by virtue of their own inventory;
- ② Through the Internet of things electronic label technology, the platform can input the inventory information of private science and technology enterprises into the system with the help of standardized interface;
- ③ Use big data, Internet of Things and other digital technologies to obtain inventory value evaluation information in real time and issue assessment certificate, which shall be submitted to financial institutions by the platform;
- ④ Financial institutions evaluate the off-line credit status of private science and technology enterprises in multiple dimensions and make credit decision;
- ⑤ The platform signs a pledge contract with the private science and technology enterprises and requires them to transfer the inventory to the designated local logistics enterprises;
- ⑥ Logistics enterprises shall check and accept the inventory, and continuously supervise the inventory status to provide real-time data for the loan of financial institutions;
- ⑦ Goods revenue of private science and technology enterprises is automatically and fully transferred to financial institutions by payment and settlement center of the platform. If the loan is repaid, the pledge contract will be invalid;

The above process shows that inventory value evaluation, inventory pledge and future sales revenue repayment are the key control points of digital supply chain finance model based on inventory pledge. This mode requires the platform to establish a huge Internet of Things system. Using information receivers such as QR code reading equipment, infrared sensor and radio frequency identification device, we can accurately detect temperature, concentration, volume, density, quality and other information of inventory in the storage, and convert information of offline goods into online data so as to realize the seamless connection between online and offline. Therefore, we can solve the problem that it is difficult and expensive to evaluate the value of chattel pledge of private science and technology enterprises, which mainly includes a large number of high-tech inventories such as electronic components, new materials, pharmaceutical reagents, etc. We can realize the mobile alarm and real-time monitoring of inventory location transfer, goods missing and damage by video monitoring and radio frequency technology. With the help of supply chain finance platform, logistics enterprises and financial institutions realize real-time sharing of pledge information. Financial institutions can access the current information of the pledged property at any time and release the pledge with one key. In this way, it can improve the financing efficiency of inventory pledge of private science and technology enterprises and better adapt to their financing characteristics. Finally, the closed self-compensation system ensures that the sales revenue of inventory flows back to financial institutions.

Digital Supply Chain Finance Model of Based on Accounts Receivable

This financing mode usually takes place in the sales link of enterprises. Private science and technology enterprises located in upstream suppliers apply for loans with receivables as pledge and take future payment of customers as repayment source. The specific business process is shown in Figure 4.

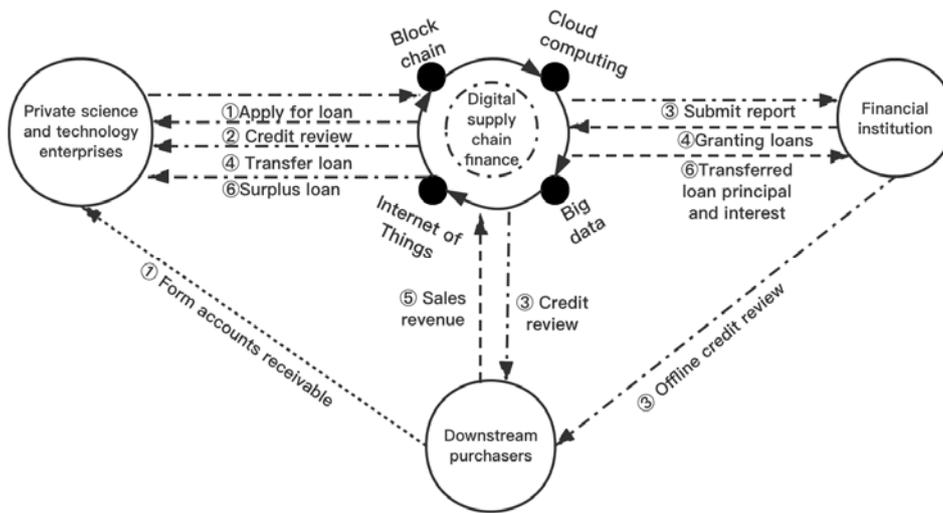


Figure 4: Technological process of digital supply chain finance model of based on accounts receivable

- ① Private science and technology enterprises sign sales contracts with downstream purchasers, and apply for loans online with receivables as pledge;
- ② The platform uses blockchain and Internet of Things technology to comprehensively review and evaluate the operation, repayment ability and credit level of upstream and downstream enterprises, and submit the information report to financial institutions;
- ③ Financial institutions carry out multi-dimensional comprehensive evaluation in combination with online evaluation reports and offline credit records of upstream and downstream enterprises;
- ④ Financial institutions provide credit to private science and technology enterprises, and payment and settlement center of the platform will transfer the funds to private science and technology enterprises;
- ⑤ Downstream enterprises in supply chain will transfer the sales revenue as the repayment source to the payment and settlement center of the platform, the platform will repay the principal and interest to the financial institutions. The balance will be transferred to the private science and technology enterprises;
- ⑥ If the financial institution obtains the principal and interest of this financing, the pledge contract of accounts receivable will automatically become invalid.

In the above process, the authenticity of accounts receivable, the quality of accounts receivable and the future payment of customers are the key control points of digital supply chain finance model of based on accounts receivable. Due to the application of blockchain technology, the chain block structure based on time stamp can realize the traceability of each transaction process, prevent upstream and downstream enterprises from defrauding loans by false sales activities. All relevant subjects in the platform participate in bookkeeping and generate a distributed ledger for collective maintenance, which can ensure the authenticity of receivables and claims. In addition, the platform uses big data to establish credit archives for enterprises and continuously updates the contents of the archives in real time. The platform realizes the comprehensive audit of the quality of claims in combination with cloud computing and uses intelligent contract to complete online automatic approval and payment. Finally, a strict self-compensation system ensures that future payment of customers will be returned to financial institutions in time.

Digital Supply Chain Finance Model of Based On Intellectual Property Pledge

This financing mode is suitable for the transaction scenario of intellectual property transfer between private science and technology enterprises and their partners. It requires that digital technology be used to build information sharing modules related to intangible assets. Private science and technology enterprises use the future income right of intellectual property of the transferee enterprise as pledge to loan to financial institutions, and the intellectual property transfer fee payable by the transferee enterprise as repayment source. The specific business process is shown in Figure 5.

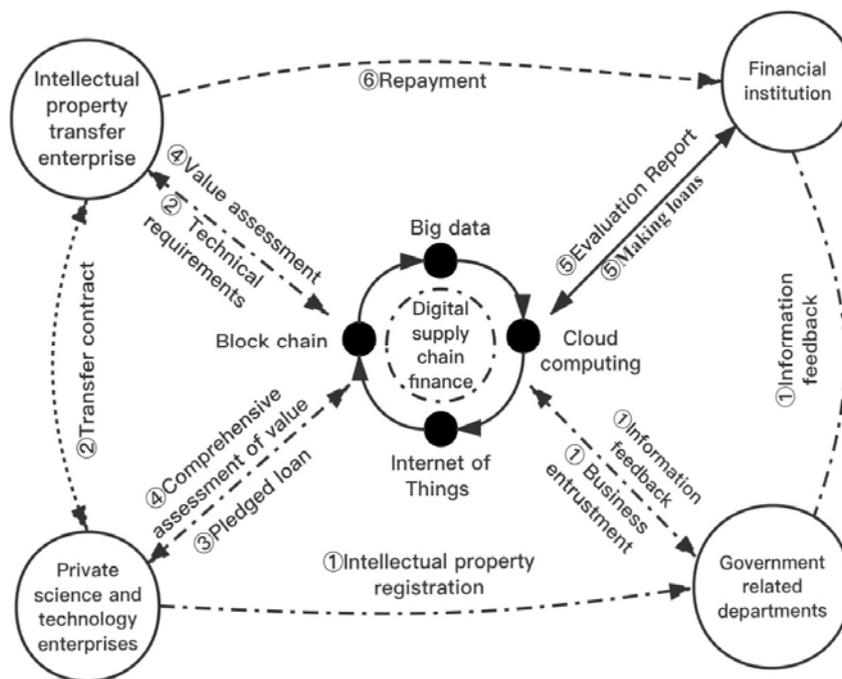


Figure 5: Technological process of digital supply chain finance model of based on intellectual property pledge

- ① Private science and technology enterprises register their intellectual property rights with relevant government departments, and The platform uses standardized interface to introduce intellectual property information held by relevant government departments (such as science and Technology Bureau, intellectual property trading center, etc.) through standardized interfaces.
- ② The platform uses digital technology to build the information sharing module of intangible assets, realizes the docking between private science and technology enterprises. Intellectual property transfer agreement signed by both parties.
- ③ Private science and technology enterprises submit the application for intellectual property pledge loan online.
- ④ The platform uses digital technology to screen and judge information. It evaluates the application value, future earnings and operation status, development potential and technology prospect of intellectual property rights of private science and technology enterprises. The platform also analyzes the operation and profit status before and after the application of intellectual property rights by the transferee enterprises;
- ⑤ Financial institutions make loan decisions based on the evaluation results submitted by the platform and the agreements signed by both parties of technology supply and demand, combined with the offline credit status of private science and technology enterprises and the business performance and credit status of the transferee enterprises;
- ⑥ The transferee enterprise organizes production by using intangible assets such as patents and trademarks, and pays the transfer fee to the platform as the loan repayment source of the financing enterprise according to the agreement.

Integrated with the above processes, intellectual property information sharing and value evaluation, intellectual property income pledge and intellectual property transfer fee repayment are the key control points for the operation of digital supply chain finance model of based on intellectual property pledge. By using Internet, big data and other technologies to establish intellectual property sharing module, we can overcome the information asymmetry between private science and technology enterprises and intangible assets transferee enterprises, which can realize the sharing of advantageous resources within the supply chain. With the help of big data, cloud computing and artificial intelligence, the feasibility, market value and future development prospect of intellectual property can be comprehensively analyzed and evaluated, which can quickly make a reasonable judgment on the value of intellectual property. The pledge loan based on the income right of intellectual property is a supply chain finance innovation in line with the knowledge intensive characteristics of private science and technology enterprises. The income right of intellectual property is the core pledge of supply chain finance, which belongs to the guarantee category of right pledge. The new profit created by the transferee after using intellectual property is an important source for private science and technology enterprises to collect the transfer fee of intellectual property. Therefore, the platform needs to combine the application of digital technology and check whether the income right of intellectual property is guaranteed. Thus, the platform grasps the operation status of the transferee before and after using the intangible assets and uses the intangible assets evaluation method to accurately estimate the value of the income right of the intellectual property transfer and provides the decision basis for the financial institutions to provide the credit line. Finally, the repayment of intellectual property transfer fee also reflects the characteristics of capital return of supply chain finance self-compensation.

GOVERNANCE STRATEGY OF DIGITAL SUPPLY CHAIN FINANCE APPLIED IN PRIVATE SCIENCE AND TECHNOLOGY ENTERPRISES

The characteristics of digital supply chain finance can promote the above-mentioned different supply chain finance models to provide high-quality services to private science and technology enterprises. However, as the development of digital supply

chain finance in China is still in its infancy, there are some constraints in the practice of providing financing services for private science and technology enterprises, which restrict the effect of financial services. First of all, the operation risks of supply chain finance include external environment risks, supply chain network risks and supply chain enterprise risks (Jüttner, Peck & Christopher, 2003). The high-tech characteristics of pledge of private science and technology enterprises increase the external environment risks and enterprise risks. The dynamic and conductive characteristics of the complex network structure of digital supply chain finance expand the risk sources of supply chain finance from enterprise end to platform network terminal. Secondly, the inadequate application of digital technology has brought technical bottleneck to supply chain finance. The application of block chain, Internet of Things and other technologies in the field of supply chain finance is not mature. The separation of different data systems from the industrial end, financial end and other service end increases the difficulty of exerting big data efficiency. The insufficient application of digital technology has become the barrier of supply chain finance innovation (Guo, Shi, & Wang, 2014). Finally, the legal system related to digital supply chain finance is not perfect. The existing laws and regulations are far from meeting the legal needs of relevant business development. In order to promote the efficient implementation of digital supply chain finance for private science and technology enterprises, it is very important to formulate reasonable strategies for the problems in the development process.

Strict Control Of Risk Sources And Avoiding Risk Of Digital Supply Chain Finance

Digital supply chain finance needs to focus on avoiding risks from external environment, supply chain structure layer and supply chain element layer.

Risk management from the external environment

Changes in the external environment such as economic environment and industrial policy will affect the value of pledge of private science and technology enterprises, especially the rapid development of science and technology accelerates the upgrading of products, which makes it easy for private science and technology enterprises to obtain the value of pledge of supply chain finance services to be misestimated by the market. In addition to force majeure, most of the exogenous risks can be perceived and dealt with (Song & Yang, 2018). The management team of supply chain finance platform is required to be good at using various digital technologies to have good sensitivity and coping ability for the exogenous risks from the economy, supervision and policy related to private science and technology enterprises.

Risk prevention of structure layer in the supply chain

The structural design of supply chain will affect the efficiency and effect of risk management (Craighead *et al.* 2007). The structural risk mainly comes from the two dimensions of network structure and business structure. It is necessary for the supply chain finance platform to plan the network status and role of the participants so that the roles of each subject are clear, the work is clear, and a stable and effective supply chain finance ecosystem is formed. The platform needs to design the business structure reasonably, make each business link connect with each other, and realize the effective closure of business structure according to the characteristics of different pledge of private science and technology enterprises. The uncertainty and potential risks of various trading businesses are prevented through the above measures.

Risk control of element level in the supply chain

Factor level risk mainly comes from financing subject and capital object. The non-bureaucratic control characteristics of the network structure can easily breed opportunism and moral hazard of the financing subject. The nodes with poor credit rating can be excluded by establishing the access and assessment mechanism of upstream and downstream enterprises in supply chain (Dou & Zheng, 2019). In view of the risk of incomplete value evaluation brought by the characteristics of intellectual density and growth of private science and technology enterprises, the platform can increase the non-financial "soft power" assessment such as innovation ability, enterprise quality and transformation ability of scientific and technological achievements based on the assessment of traditional financial indicators such as transaction amount, asset scale and cash flow. Thus, we can create a fair, just and mutually beneficial service environment. The risk control of capital object needs to focus on the highly matching of financial business and supply chain industrial activities, which can control the risk of platform fund raising. The platform follows the self-compensation logic to design the capital return procedure and control the risk of capital release and recovery.

Accelerated Application Of Digital Technology And Enabling Ecological Innovation Of Supply Chain Finance

The technology wave generally goes through two stages: infrastructure, stimulate and harvest the full economic and social potential. At present, digital technology is in the stage of infrastructure construction in China. The immaturity of digital technology and inadequate application of technology restrict the service quality of supply chain finance. Digitalization means that it can be divided and recombined, and each standardized element presents different combinations and structural models, which will bring product innovation and model innovation, and even lead to industrial revolution. Hence accelerating the application of digital technology can give innovation energy to supply chain finance ecology.

Acceleration of digital innovation of industrial ecology

Digital supply chain finance is based on the digital new supply chain business network, and industry digitalization is the premise and key of its operation. Based on the existing knowledge reserve and data, driven by the new generation of science and technology, the industry of private science and technology enterprises should strengthen the deep integration of "industry + technology", complete the digitalization of assets online and the visualization of business process scenarios as soon as possible,

so as to realize the transparency and intensification of the whole industry chain and create good business conditions for the operation of digital supply chain finance.

Leading digital transformation of financial business

At present, financial institutions need to do a good job of supply chain finance around the industrial ecosystem and implement digital transformation under the guidance of financial science and technology. Financial institutions should fully integrate supply chain finance and digital technology; besides, they should implement strategic cooperation, system compatibility and platform docking to provide private science and technology enterprises with new digital business processes, digital financial products, digital risk control systems according to the individual characteristics of the enterprises. Namely, Financial institutions and industrial chain should work together to strengthen the industrial and financial ecosystem

Promotion of digital infrastructure construction

Government functional service agencies and social intermediary service agencies should actively promote the open sharing of e-government information and e-service information. Such information sharing can promote the full application and cross validation of various data from different sources in the digital industry and finance ecosystem, jointly enable the innovation and development of digital supply chain finance and create a better financing environment for private science and technology enterprises.

Perfection Of Laws And Regulations System And Standardization Of Development Of Digital Supply Chain Finance

The diversification of participants and business models in digital supply chain finance puts forward higher requirements for the coverage of laws and regulations. In order to solve the problem of legal constraints in the process of digital supply chain finance providing services to private science and technology enterprises, it is very important for the Chinese government to improve the legal and regulatory system from the top-level design.

Amendment and promulgation of relevant laws according to the development process of digital supply chain finance

On the one hand, based on the existing financial laws and regulations such as insurance law, commercial bank law, electronic signature law and securities law, the relevant provisions are revised, improved and supplemented, especially the qualification of platform operators, information transmission mechanism and algorithm technology are regulated from the legal level. Therefore, the financial operation and management of digital supply chain can be governed by laws. On the other hand, new laws and regulations should be issued in time to clarify the responsibilities and obligations of all participants so as to provide legal basis for eliminating the conflicts caused by the imbalance of power allocation and interest distribution in the digital supply chain finance system.

Improvement of the supporting laws and regulations system of private science and technology enterprises

In order to improve the service quality of digital supply chain finance to private science and technology enterprises, it is necessary to improve such laws and regulations as general principles of civil law, contract law, property law and administrative measures for scientific and technological evaluation.

In addition, the guarantee laws and regulations should be revised so as to expand the scope of chattel mortgage from inventory and accounts receivable to intangible assets such as intellectual property, carbon rights, etc. The above measures can provide more legal support for private science and technology enterprises to use intangible assets and other special pledges.

Construction of coordination and supervision mechanism of joint management

Digital supply chain finance needs the coordination of regional regulators because it has obvious cross domain and cross space-time characteristics. Hence Government departments at all levels should clarify the scope of responsibilities of the corresponding regulatory bodies as soon as possible. We should pay attention to the regulatory function of industry association of digital supply chain finance. The trade association regulates all kinds of arbitrage, arbitrage and financing trade activities, curbs all kinds of speculative businesses. In addition, we should also pay more attention to the punishment of illegal activities in the field of supply chain finance. The above measures can provide a good legal environment for private science and technology enterprises to use digital supply chain finance.

CONCLUSIONS

With the mature application of digital technology, supply chain finance presents the characteristics of precise financial services, divergent credit enhancement and intelligent risk management and control. It can break through the service bottleneck of traditional supply chain finance in terms of cost, efficiency and risk control, and provide excellent financial services for more and more private science and technology enterprises. Therefore, digital supply chain finance is a very promising financing scheme for private science and technology enterprises.

Based on the comprehensive influence of various digital technologies such as big data, Internet of Things, blockchain and artificial intelligence on the supply chain finance business model under different application scenarios, we analyze the operation process optimization of digital supply chain prepayment financing model, digital supply chain inventory pledge financing model and digital supply chain receivables financing model in the innovative application of private science and technology enterprises in this paper. Furthermore, according to the characteristics of "light assets, heavy technology" of private science and technology enterprises, we put forward digital supply chain finance based on intellectual property pledge in

this paper. We focus on the process optimization and key point design of the application of these four financing modes in private science and technology enterprises. In order to promote the sound operation of digital supply chain finance in private science and technology enterprises, we put forward corresponding governance strategies for the constraints existing in risk management, technology application and legal system in the process of digital supply chain finance serving private science and technology enterprises in this paper.

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Research Review on Artificial Intelligence Technology to Provide Design of Man-machine Interaction in Industry and Product Design

(Full Paper)

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ABSTRACT

This paper discusses the "human-computer interaction medium", "interactive object", "application of artificial intelligence" and "human-computer relationship" in the era of artificial intelligence in the recent years. It's focused on "human-computer interaction of artificial intelligence", based on the in-depth research and insight into advanced technologies, products and designs in the field of artificial intelligence over the past year and combined with the experience of industry and academia. The development trend has formed the design insight in this field, and summarized eight trends of artificial intelligence human-computer interaction. The application of artificial intelligence human-computer interaction design in universities and enterprises related to specific projects of industrial design provides important theoretical support and practical verification for the teaching and scientific research work of industrial design specialty and the further development and growth of industrial design industry in universities and colleges of our country. The application of artificial intelligence technology in universities and enterprises is also demonstrated.

Keywords: Artificial Intelligence, human-computer interaction, industry and product design, interactive design

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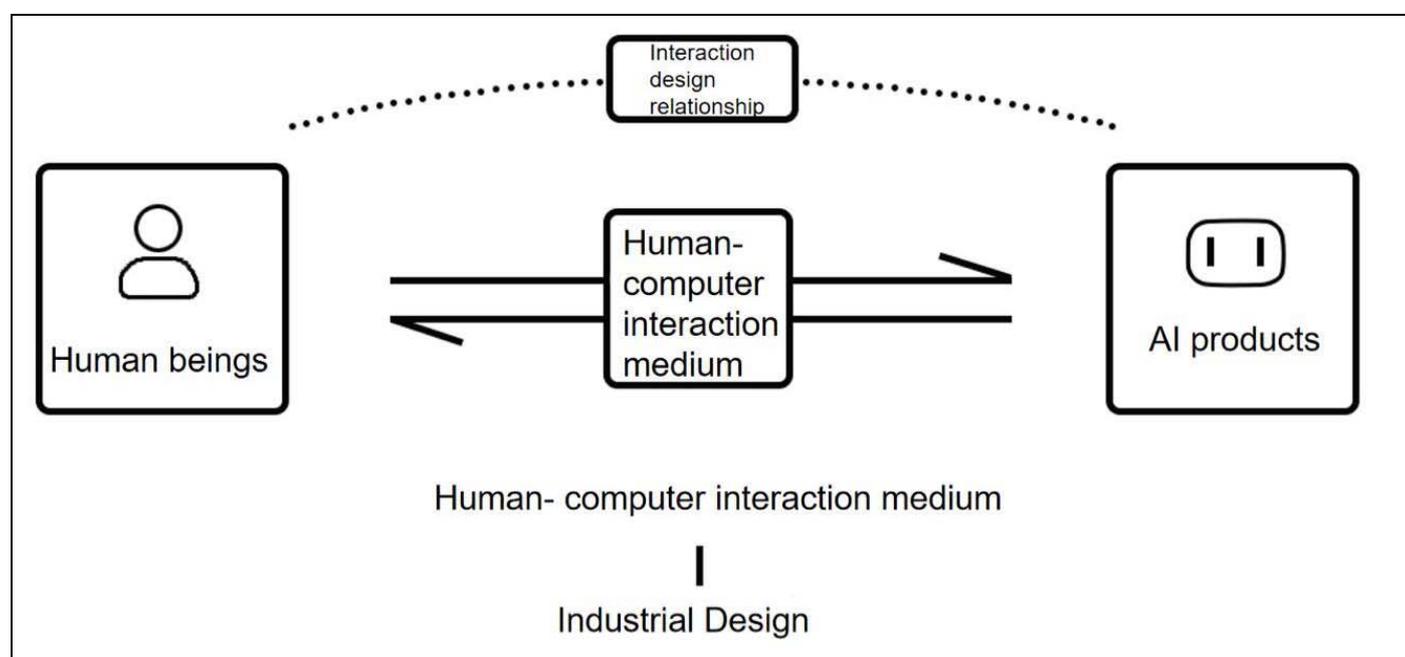
INTRODUCTION

In recent years, the Ministry of Industry and Information Technology has emphasized the deep integration of Artificial Intelligence (AI) with the real economy and manufacturing industry, the development of intelligent products and equipment, and the promotion of the overall upgrading of China's manufacturing products and equipment to "intelligent generation", which is one of the keys to the implementation of Made in China 2025 (Lu, 2015). Under the background of AI, the research of human-computer interaction in industrial design based on AI technology is of great significance to the further development of intelligent design, industrial design transformation, humanized design, interactive design and design services.

In the "Industrial 4.0" era, the global scale of industrial wisdom development is increasing day by day, and its impact on the contemporary cultural industry can't be underestimated. It is mainly based on nine digital industrial technologies, such as Internet of Things, Cloud Computing, Industrial Big Data, Industrial Robot, 3D Printing, Virtual Reality and Artificial Intelligence. Driven by the technology of big data, artificial intelligence and virtual reality, the innovative ability of traditional design industry is constantly improving (Lu, 2012). In the face of unprecedented subversive changes brought about by emerging technologies, the future development of industrial design has ushered in tremendous opportunities for development. The core of "Industrial 4.0" is the value creation of high and new technology. China is not only a big manufacturing country, but also a big using country. The development of intelligent design is growing in China. China is expected to become one of the biggest beneficiaries under the wave of "Industrial 4.0". As a national development strategy, under the background of "Industry 4.0", China's industrial design industry is facing the opportunity of change of the times.

The term "artificial intelligence" was first proposed at the Dartmouth Society in 1956. Artificial Intelligence (AI) is a branch of computer science. It explores the nature of intelligence and creates human intelligence that can respond in a way similar to the purpose of intelligent machines (Pu, 2018). Artificial intelligence is the closest relationship between scientific and philosophical topics. Its research results gather knowledge from psychology, linguistic neuroscience, logic, mathematics, computer science, robotics, economics, sociology and other disciplines. Artificial intelligence research not only enables machines to solve problems, but also pays attention to the self-learning ability of machine research, so that machines can accumulate life experience and wisdom like intelligent creatures, constantly sum up lessons, correct mistakes, improve performance, adapt to changing environment, and also have the ability to discover and invent. This has also become the main content of AI and intelligent design.

Whether it is the definition of industrial design given by the International Industrial Design Association (ICSID) in 1980 or the latest explanation of "design" by ICSID, the importance of "human-computer interaction" in the field of industrial design is clearly stated. With the development and maturity of computer network technology, based on the application of computer-aided industrial design (CAID), interactive design mode based on software design research has also been studied and applied to achieve the goal of usability and user experience humanized design. The research of product human-computer interaction technology model involves the fields limited by cognitive psychology and computer science, often. It embodies the concepts of user interface design (Chen, 2017), information visualization technology flow (Tan, 2018), mobile applications and technology consumption mode theory (Yang, Ma & Sun, 2017), etc. Especially since the 1970s, due to the development of AI based on knowledge acquisition, the research of human-computer interaction in AI is particularly important. In the past two years, AI has developed rapidly. Technically, from the application of single-point technology such as voice control and face recognition, to the development of multi-modal computing that integrates vision, voice and semantics; in application, the force of historical change of artificial intelligence is accelerating the penetration of all walks of life, from product services, to production, operation, to decision-making, in terms of reducing costs, risks, shortening processes, bringing in value-added income and improving production efficiency. In terms of policy, AI has also risen to the strategic position of the country, and related policies have been frequently adopted to encourage industrial development at the national level (Shan, 2017). Technology development, application landing and policy support drive the rapid development of artificial intelligence. Artificial intelligence has changed the way we interact with machines, affected our lives, and redefined our relationship with machines. In the era of artificial intelligence, the change of interactive design is not an evolution, but a reconstruction. It will reconstruct the tools, productivity, life and even aesthetics around us. The relationship between Human-computer interaction and Product Design is shown in Figure 1.



Source: This study.

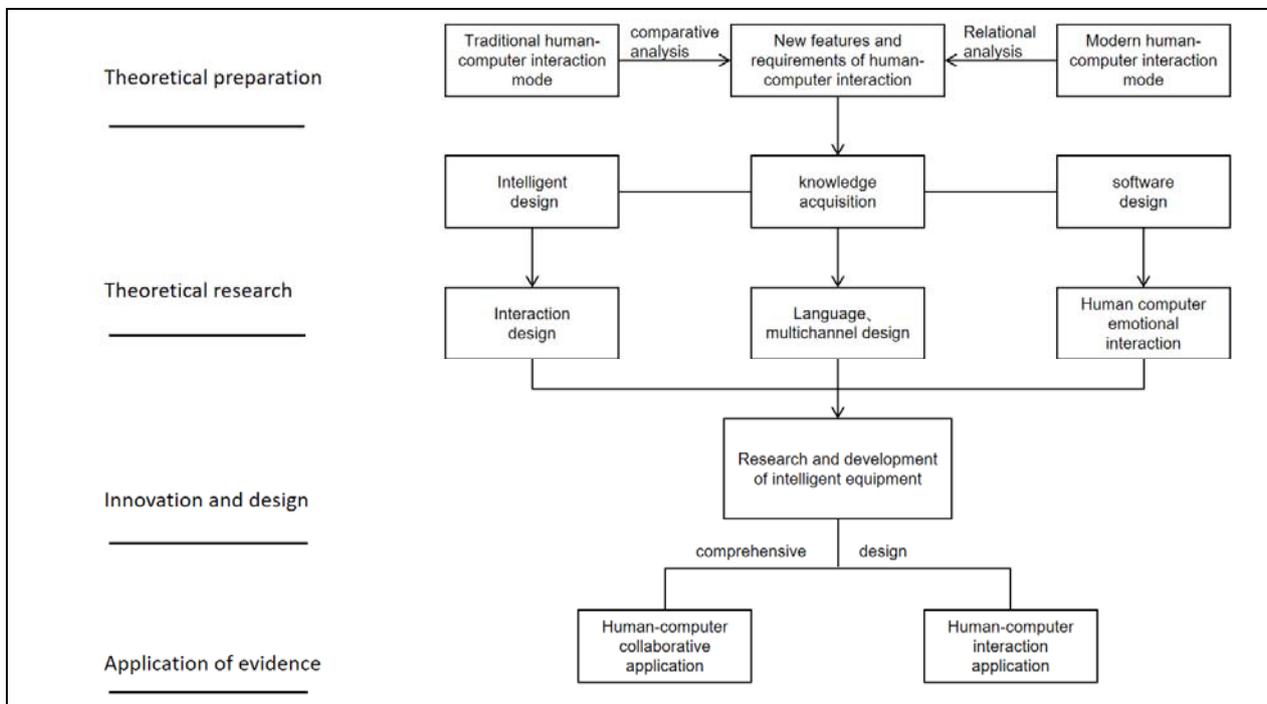
Figure 1: Relationship between Human-computer interaction and Product Design.

THEORETICAL RESEARCH AND PRACTICAL APPLICATION OF RESEARCH

Artificial intelligence (AI) technology has developed rapidly in recent years, but it belongs to a new field after all. The development time is relatively short and there are many technical problems. All along, the machine learning ability of AI is a "bottleneck" in the field of AI. On the one hand, machine learning restricts the development of artificial intelligence and machine learning; on the other hand, in view of the close relationship with other fields, it requires researchers to work on machine learning, while the development of other fields can be found in new learning algorithms and other areas of learning institutions, thus promoting the new development of machine learning. In view of this, on the basis of the application of the existing artificial intelligence technology, this topic intends to make up for the lack of research on related issues, try to establish an analytical framework for the study of human-computer interaction in industrial design, clarify the analytical methods and technical routes, and make a comprehensive study of human-computer interaction in industrial design from a new perspective. Then, it is necessary to implement the artificial intelligence technology in universities. Empirical research is carried out in enterprises.

The basic research idea of this study is to study the difference between human intelligence and artificial intelligence from the new features and new requirements of the man-machine interaction in the artificial intelligence times through the literature review of the development history of artificial intelligence. The difference and disadvantage of the traditional man-machine interaction mode and the modern man-machine interaction mode are analyzed and compared, the interactive design pattern

based on the intelligent design is studied, and the voice interaction and the multi-channel fusion interaction are realized based on the knowledge acquisition technology, And based on the software design study, the human design and the form of emotional interaction have laid a theoretical foundation for the research of the ability of the intelligent body and the intelligent body to start to have the emotion judgment and the feedback intelligence. Through the research of the intelligent equipment from the man-machine direction to the depth, the building of the trust becomes the first point of the analysis, and then the design of the human-computer interaction application which can realize the humanized and personalized human-computer interaction application of the intelligent product in the artificial intelligence time is explored. The basic research framework is shown in Figure 2.



Source: This study.

Figure 2: Research ideas and methods between Human-computer interaction and Product Design.

Based on the application of existing artificial intelligence technology, starting from the research progress of voice interaction technology, it tends to the perspective of human natural dialogue experience:

- (a) Researching more mediums such as face, gesture and other channels, multi-channel fusion interaction becomes the mainstream interactive form. Research on how intelligent agents begin to have clear human relationships;
- (b) Research agents begin to take active interactions outside passive interactions;
- (c) Study how intelligent agents begin to have emotional judgments and feedback intelligence;
- (d) Rapid development and application of artificial intelligence to specific populations Research on the interoperability of smart devices, multi-scenario convergence;
- (e) From human-machine to deep coordination, trust construction has become the primary breakthrough point.

Establish an analytical framework for researching human-computer interaction in industrial design, clarify analytical methods and technical routes, and study the human-comp.

HOW TO COMBINE ARTIFICIAL INTELLIGENCE WITH DESIGN

The main goal of artificial intelligence is to machine human intelligence. Once it is implemented, it will produce revolutionary changes, because the characteristics of machines are fast and tireless, which is superior to human beings. If people's intelligence is mechanized, machines will judge, analyze and choose like people. Creative activities can also be carried out. Now some people use artificial intelligence to analyze lottery tickets, and some people have carried out man-machine war. The results prove the feasibility of artificial intelligence. This can also prove its broad prospects in the field of design. Using artificial intelligence, product design can be carried out quickly, omitting some bedding links, and making design a procedural process (Chen, 2017). So far, substantial progress has been made in this work. From the perspective of development trend, artificial intelligence has entered a period of rapid development. For design, intelligent conceptual design software has entered the practical operation stage and is in the process of continuous improvement. We have reason to believe that with the joint efforts of computer experts and new designers, the combination of design and artificial intelligence is not far off.

Application of artificial intelligence in product design: With the development of artificial intelligence, it has been widely used, and has become the core driving force of industrial transformation, which has a profound impact on the development of world

economy, social progress and the improvement of human living standards. In the field of design, combined with the research of related products, it is found that the application of existing intelligent products mainly has the following directions:

Smart Home Products

With the development of Internet of things technology, smart home has been implemented and applied. Relevant enterprises have designed smart home products around smart phone app. The smart ecosystem is developed by Xiaomi company, through the way of creating typical practical products - Investment Enterprises - multi field cooperation, creates the smart ecosystem of Mijia, and takes the lead in establishing the business model of "hardware platform – crowd-funding - shopping mall". Under this model, the R & D, landing and promotion of smart home products are more smooth, which also ensures that Xiaomi company is the leader in smart home The status of the domain. At the same time, Xiaomi company has developed smart speakers, sweeper robots, smart home cameras and other products to create a rich and comprehensive smart ecosystem. In addition, Alibaba has also established an open platform for smart life, and launched small smart speaker in 2017, marking that it has gradually started the hardware layout of smart home. Google developed the Google home speaker and Amazon launched the echo speaker. The development of smart home platform is also constantly stimulating the transformation and development of traditional home appliance enterprises such as Haier and Midea, and actively promoting the intelligent transformation of their products to build their own smart home platform. The Smart home products – Xiaomi “Tmall Eif” is shown in Figure 3.



Source: Baidu pictures.

Figure 3: Smart home products – Xiaomi “Tmall Eif”

Application of artificial Intelligence in the Design of small Household Appliances: Xiao Ya sound box - focus on experience and service, technology and content, from point to face to connect the small appliances in the environment. iFLYTEK, a small translation translator, has realized the function of real-time speech input and translation, and has become a travel helper for more than a dozen Mandarin languages and more than a dozen national translators. Google clip-ai camera, which uses artificial intelligence technology to take photos, actively screen scenes, video according to the host preferences, and so on, to help users record those meaningful moments. The camera learns to use AI to automatically look for "interesting" scenes, and by constantly analyzing users undefined preferences to independently judge the content of the shot, so that each AI model in the machine learns the trend of a large amount of data through the feedback of the host, and finally constructs a model to meet the needs of the user.

Smart Wearable Device

Intelligent wearable devices, that is, products are worn on the body, and information can be more easily and directly presented to users, users can also interact with them directly. As far as the current market is concerned, the existing intelligent wearable devices are mainly smart watches and related accessories. At present, apple, Samsung, Huawei, Xiaomi and other enterprises have launched smart watches / bracelets. In addition to the traditional watch functions, these products can also carry out health monitoring and management, real-time SMS and mobile phone calls, as well as rich entertainment functions. Among them, apple recently released the apple watch - Series 4 product, which provides a more accurate and humanized fall detection function. The smart watch extends from the front intelligent life service to a more detailed security service.

Intelligent wearable products are the key fields of artificial intelligence applications. The changes brought about by their development can be extended to the unlimited expansion of human individual capabilities, the transformation of human world communication and existence forms. The Smart wearable device – smart Watch – Series is shown in Figure 4.



Source: Baidu pictures.

Figure 4: Smart wearable device – smart Watch – Series

The use of artificial Intelligence in Medical products

Watson Oncology solution-learn about the latest developments in the subject through a wealth of research, medical records, and clinical trials. Now, through the cooperation between IBM and MSK, Watson uses the expertise of the world-renowned MSK company to assess and analyze the specific situation of each patient in depth. Watson Clinical trial matching-helps identify potential candidates for clinical trial matching. By using cognitive calculation, Watson can analyze the characteristics of potential candidates in clinical trials, and help clinicians to select suitable candidates for clinical trials more quickly and effectively by evaluating the extent to which these candidates meet the relevant conditions.

Other Smart Devices

The generation of intelligent devices relies on the development of intelligent technology. The application of artificial intelligence mentioned above is mostly the design of intelligent products, and intelligent robots are also widely developed devices. The reasonable application of different technologies has produced a variety of intelligent robots suitable for various environments. The intelligent robot shows the understanding and communication ability of artificial intelligence incisively and vividly, and through the analysis of its own environment, it can actively make actions to meet the operator's requirements, and even can make intelligent activities such as judgment, logical analysis, understanding, etc. The product application of intelligent robots is still dominated by service robots, such as service robots in restaurants and shopping malls, as well as home-work robots and children's companion robots. Although it is rarely used in daily life, the position of intelligent robot is particularly important in today's society, and the heat of related technology research is rising.

Application of artificial Intelligence in Traffic Travel products

Waymo-- reduces the error rate of driverless car through the intervention of AI, grasps the learning result of neural network through the study of artificial intelligence, enables the unmanned vehicle to predict some emergencies or emergencies quickly, and gradually improves the overall level of automobile intelligence, such as: auxiliary, partially automatic, highly automatic and completely self-driving four different application modes. Combined with the pedestrian recognition, vehicle recognition, obstacle recognition, there are three major environmental awareness technologies.

HOW AI SUPPORTED PRODUCT DESIGN AND EMBEDDED IN SMART PRODUCT FOR INTERACTING WITH USERS

Innovation of Product Design Thinking

The most important thing in production design is thinking innovation. Under the influence of artificial intelligence technology, production, the change of product design thinking is the highlight of innovation (Tan, 2017). The biggest pursuit of AI is to realize.

People's thinking ability and judgment ability, but judging from the current technological development, artificial intelligence has wisdom Strength without the smart, intelligence without Eq. AI can replace many parts of production design. But it has not been involved in reasoning, thinking, overall planning and cultural integration (Huang, 2016). Therefore, under the influence of artificial intelligence, product design should focus on emotion and humanity; In addition, the current artificial intelligence is not separated from human intelligence, which is always designed under human intervention. When the two cooperate, people should pay more attention to the interaction with artificial intelligence in product design. The artificial intelligence in product design can be regarded as a collection of the great achievements of human product design in the past, so our thinking in product design should be creative, original and open Finally, the thinking innovation of product design is more likely under the support of artificial intelligence, while eliminating the theoretical research of tedious literature, making the design thinking stand on the shoulder of artificial intelligence.

Innovation of Product Design Method

Artificial intelligence technology can replace and assist human designers in product design. At present, AI has not completely changed the process of product design, but in product design. The method has been innovated. Specifically, there are the following aspects: Firstly, by interacting with designers, AI Only the investigation results of similar design in the past can be obtained, and the success of such design can be more analyzed and judged in the research stage of product design. The advantages and disadvantages are available for designers to choose from. Second, On the one hand, artificial intelligence can select the past for designers in the design stage. On the other hand, it can make the design idea intuitive, through the cognitive model construction and processing of design analysis, the potential design ideas are simulated, Let the vision, technicality and feasibility of the design idea be presented through VR, 3D printing technology, etc. Column, assist the designer to analyze several design ideas and provide solutions to each idea. In order to make the design more targeted, advanced, original and feasible, we should eliminate the interference as much as possible. Third, the design prototype can be tested and optimized in the artificial intelligence environment by using artificial intelligence software to test function and mature calculation in the design stage. The intelligent debugging function includes several major modules such as vision, language, language, interaction, knowledge, search and so on. It carries out design inspection, model detection, voice interaction, emotional analysis and so on for product design. Under the operation of the designer, artificial intelligence presents the optimization results directly, and its advantages, disadvantages, characteristics and so on are clear at a glance. Fourthly, the verification stage of the thinking and requirements of product design are constantly updated iteratively. The solutions in the design may become the starting point of design update. The results of product design optimization are tested and verified to make the feedback of product design more accurate and more conducive to the improvement and perfection of designers. In the traditional design process, this step is tedious and time-consuming. In the artificial intelligence environment, it can shield the previous unilateral defects of verification, not only from the macro perspective, but also from the micro perspective (Liu & Gao 2016). For example, A / B test is carried out on the verification algorithm, and at the same time, it is compared with the design in the database to get the approval degree, so that the product design of the success rate is higher.

Innovation of Product Design Requirements and Objectives

Under the influence of artificial intelligence technology, product design is closer to industrialization, and it is easier to mass produce after design. After thousands of years of evolution, the requirements of product design in the artificial intelligence environment, including function, shape, material, color, ease of use, uniqueness, culture and so on, have changed. Under the demand innovation, the design goal is more complex, more hierarchical and inclusive. In terms of function, from single to overlay, from single, heavy to diverse, light and thin, materials from only to diverse, colors from simple to diverse and then to simple. These design goals are the requirements of the times, the talents given to designers by artificial intelligence, and also higher requirements for designers.

WHAT ARE THE FUTURE PERSPECTIVES IN THE ABOVE TWO ASPECTS

The development of artificial intelligence has gone through more than 60 years, and its overall development level is still in the initial stage (Tan, Zhang & Xu, 2016). Especially, in the field of product design, the research and application of artificial intelligence still has a long way to go. As far as the current situation is concerned, its development trend can be roughly analyzed as follows:

The Design of AI Products Should be Guided by "Human Characteristics".

Human brain is a general-purpose intelligent system, which can draw inferences from one example and make a comprehensive understanding. It can flexibly handle a variety of feelings and perceptions, and can learn, reason, judge, think, plan, design and other issues. At the same time, human is unpredictable and capricious. The premise of intelligent product application is human needs, but these machines can only provide some speed, power or consistent operation that human cannot achieve, and lack of social, imagination and empathy. Machines do not know the impact of their behavior on the surrounding. In other words, in the current artificial intelligence, there is intelligence without intelligence (unconsciousness and comprehension, lack of comprehensive decision-making ability), intelligence without emotional intelligence (lack of emotional understanding and communication ability of machines), accounting can't "calculate", there are experts without generalists. Therefore, although the current intelligent products are practical, there is still a long way to go before they are "easy to use".

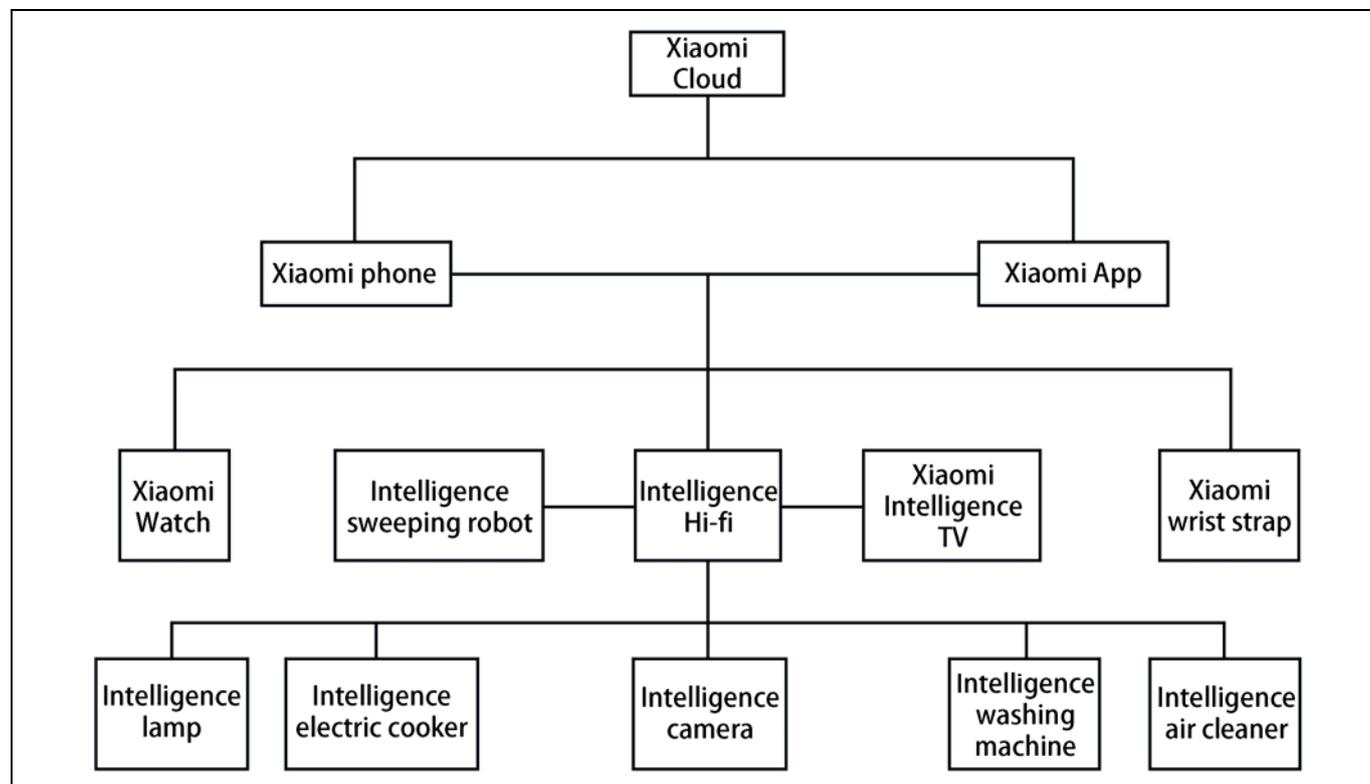
Artificial Intelligence Products Should Aim at "Human-Machine Integration" and Pay Attention to "Intelligence".

At present, artificial intelligence is still inseparable from the word "artificial". Xie, Xia and Pan (2019) said that most products in the market are in the era of semi-automatic and semi intelligent. When users use the product, they should not only hand over the work to the product to complete, but also have to pay attention to its working state to avoid unexpected situations, which is also the performance of the current artificial intelligence application is not perfect. To realize real intelligence, we need to overcome the gap between people and machines, realize the human-machine community, and complement each other. At the same time, when giving machine (product) and multi Initiative (intelligence, even emotion and personality), the interaction between human and computer is more important, so the intelligent product must have good interaction design support.

Application of artificial Intelligence in APP Product Design

Artificial intelligence visual is recognition and speech recognition industry. The software product Mail-- can screen spam, and the new version of Mail adds the function of "Smart Compose" (Tan, 2017). By learning the language habits of users, entering words in the process of sending mail will automatically help users generate recommended possible phrases and sentences. Google News-- uses AI to intervene in the way people read news, and you watch an interesting piece of news that pushes other

relevant news. A new generation of Google assistants-intelligent assistants who can call. Using Wavelet technology of Deep Mind, six kinds of voice can be provided (Lu, 2015). For example, Xiaomi smart home system is actually around Xiaomi smart phone as the center, by Xiaomi TV, Xiaomi routing, Xiaomi air purifier, Xiaomi camera, Xiaomi smart lamps, Xiaomi body weight scale, Xiaomi bracelet and other Xiaomi ecological smart hardware composition of a smart home system. Through the linkage between each intelligent device form a certain application scene, so as to achieve intelligent home control. The Xiaomi intelligent ecosystem is shown in Figure 5.



Source: This study.

Figure 5: Xiaomi intelligent ecosystem

"Intelligent Technology" is the Main Driving Force for the Design and Development of Artificial Intelligence Products.

The development of artificial intelligence technology is the key factor of intelligent design. It attempts to understand the essence of intelligence with various principles and means, and simulate a system similar to human intelligence. Yin, Ren and He (2008) said the content of intelligent technology is diverse and highly complex, including reasoning, language recognition, natural language processing, image recognition and expert system. Since the birth of artificial intelligence, its related theory and application technology are increasingly mature, and its application field is also expanding. As mentioned above, the application of various intelligent systems and intelligent products explores people's new life style. In addition, the application of artificial intelligence in product design should not only meet the basic functions, but also pay attention to its emotional design to improve the user experience and improve the user's quality of life (Liu, Yan & Chen 2016). This century is a new era of technology development and innovation, artificial intelligence products will become more and more common. The future trend of product design is humanization, emotion and intelligence.

Five artificial Intelligence Innovation platforms in China

Baidu -- self-driving: Apollo self-driving taxi fleet; Alibaba - City Brain (Concept); Tencent -- medical imaging: tencent search, ai-assisted open platform (aggregation of the ability of a number of top artificial intelligence teams, using image recognition, big data processing, deep learning and other leading technology, and medical cross-border integration of research and development, can assist doctors in disease screening and diagnosis, improve the diagnostic accuracy and efficiency of clinicians.); iFLYTEK, HKUST - Smart Voice: Full House Smart Voice Panel; Shang Tang - Intelligent Vision: Sense Engine AI Visual Module. By the end of 2018, more than 20 provinces in China have issued more than 30 artificial intelligence special support policies. The three artificial intelligence industry agglomeration areas represented by Beijing, Guangdong and Yangtze River Delta were initially formed, accounting for 86% of the total number of artificial intelligence enterprises in the country. There are more than 1000 artificial intelligence enterprises in China. Baidu, Ali, Tencent and other technology giants have taken the lead in stepping into full-scale application, business soup, cloud from, broad view, Yitu and other head startups such as commercial competition.

CONCLUSION

In summary, with the development of new technology in the "industrial 4.0" era, the development and wide application of artificial intelligence technology, as the closest relationship between science and philosophy, its research results gather the knowledge from psychology, linguistic neuroscience, logic, mathematics, computer science, robotics, economics, sociology and other disciplines, and in the field of future industrial design. Artificial intelligence is in full swing in the current society, the application prospect of related technology in product design is very broad. In the 21st century, human beings are planning, science is studying, technology is cooperating, with the development of Internet of things, Internet of things technology, cloud space and big data application, artificial intelligence will participate in people overturn life more and more, change or even subvert people overturn life and mode of production. The process and method pattern of human-computer interaction design will change. The research on the interaction of intelligent design under the application of artificial intelligence, especially the comprehensive research on the human-computer interaction service of new industrial design, is still rare. With the development of artificial intelligence technology, the integration of intelligent elements into product design has become a mainstream direction of contemporary design. It has shown great application prospect in many fields.

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Social Commerce: Chanting the Experience of Shoppers in a Developing Country

(Full Paper)

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ABSTRACT

The proliferation of the Internet, and the recent hype/massive popularity of social media for socialization and interactions have created a new landscape of social commerce. While social commerce via websites and marketplaces is accustomed in the Western market, the recent development indicates that millennials in the Southeast Asia are taking riskier buying decisions by embarking on business transactions with individual sellers on the social networking (SNS) platforms; known as customer to customer social commerce (C2C-SC). Taking into consideration of the rapid growth and potential security issues of this type of social commerce, it is therefore pivotal to understand why shoppers tend to shop on SNS platforms although they have options to shop on a more secured platform. This qualitative study was conducted, in a developing country of the Southeast Asia, to gain in depth understanding of buyers' engagement in the rapidly growing social commerce. Based on the thematic analysis from the interviews data, findings highlighted that buyers' interest for shopping on SNS platforms was instigated from the two motivational perspectives – intrinsic and extrinsic. Intrinsic motivations consist of feelings of convenience, sense of comfort and sense of satisfaction. Extrinsic motivations are formed by inputs of other buyers, sellers' characterization and products distinct. This study is amongst the first to explore online buyers' experiences that justify their interest to purchase on SNS platforms, which emerged from the interplay of internal and external factors. Findings offer insightful explanations on the phenomenon and contribute to further development in the body of knowledge of social commerce, specifically related to C2C-SC.

Keywords: Social commerce, C2C social commerce, social media, SNS platforms, developing country, intrinsic motivation, extrinsic motivation, uses and gratification theory.

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INTRODUCTION

In the past, consumers used to go to physical stores to shop. With the proliferation of the Internet, the shopping landscape has changed into digital version via online marketplaces and websites. Nowadays, the arrival of social media for networking such as Facebook, Instagram and Twitter, has changed the shopping landscape again. Hoppe *et al.* (2017)'s market survey shows that social commerce on social networking sites (SNS) is gaining massive popularity, particularly in Southeast Asia with over 30% of online purchase take place on SNS platforms. In line with the popularity, the trend of online shopping via SNS platforms among Malaysians is also rising with 79% of social media users claimed that they bought from SNS platforms at least once a year (Talib, Hanim and Ramayah, 2018). Similarly, in Thailand, thousands of online shoppers conducted their purchase on SNS platforms (Leeraphong & Papisratorn, 2018). Online buyers use these SNS platforms to obtain product information, communicate with sellers, and often conclude their purchase there. Many studies have confirmed that online buyers prefer to shop on SNS because the product information is readily available within the social community through e-WOM (e.g. testimonials, recommendations and ratings) (e.g. Hajli, Sims, Zadeh, & Richard, 2017; Liang & Turban, 2011; Shen, 2012).

While social commerce via SNS platforms is gaining its popularity, it also comes with challenges. One of the notable problems with this type of social commerce shopping is payment. Unlike online shopping via marketplaces such as Amazon, Shopee and Alibaba, until the customers receive the products, sellers will not receive the payments (i.e. escrow method). In SNS shopping landscape, normally sellers promote their products on the SNS platforms and continue their communication with the potential customers on communication apps such as Messenger, WhatsApp and Telegram (Leeraphong & Papisratorn, 2018). Once the customers agree to purchase, payments are sent online directly to sellers' personal or business account. There is no guarantee that the customers will receive their products as promised. Worse, most of sellers in SNS are individuals instead of firms (Stephen & Toubia, 2010), which can lead to an existence of anonymous sellers. A recent study conducted among shoppers on SNS platforms in Malaysia discovered that 31.6% of them have experience being defrauded by SNS sellers (Talib *et al.* 2018). The Australian Competition and Consumer Commission (ACCC) reported that on April 2019 alone, they received 749 reports on online shopping scams with financial loss of \$585,803. Of these reported online purchasing frauds, 26.3% were conducted via SNS.

The issues of security of transactions on SNS platforms are real, with the increasing numbers of online fraud incidents around the globe. Lack of governance on transactions, anonymous identity of sellers and loose payment methods are among the alarming issues. Nevertheless, despite of these concerns, raising numbers of SNS users continue to contribute to the online

shopping activities. It is therefore pivotal to understand why buyers incline to shop on SNS platforms although they have options to shop on a more secured platform. This study will delve deeper into findings the reasons why buyers engage in this type of rapidly growing social commerce, in the context of Malaysia.

LITERATURE REVIEW

The Social Media Evolution and Implications for Social Commerce

Across the world, there were 2.65 billion users of the social media in 2017, and it is expected to grow progressively (Statista, 2019). This number had grown to almost 3.5 billion in 2019, amounting to 79.5% of the internet users worldwide (Global Digital Report, 2019). The means to access the social media have expanded from computers to smart phones. Indeed, the number of mobile social users continues to grow apace, with 42% penetration in 2019, up 3% from 2018 (Global Digital Report, 2019). In the context of Malaysia, communication via instant messaging apps such as WhatsApp and WeChat were the most popular activities among Internet users, followed by socialization via SNS platforms such as Facebook and Instagram (Malaysian Communications and Multimedia Commission, 2018).

The emergence of social media has gained tremendous popularity and is widely accepted as a new form of e-commerce, also known as social commerce. As a subset of e-commerce, social commerce is defined as an online business with integration between commercial activities and social activities (Stephen & Toubia, 2010). Commercial activities include marketing, selling and buying products and services, whereas social activities contain online interactions and user contributions. The capability of social activities that allows for users' content participation, such as reviews and recommendations, represents the major advantages of social commerce (Liang & Turban, 2011).

Prior studies categorized social commerce in two forms. The first form of social commerce is embedding social media features in e-commerce sites (e.g. Amazon, Lazada, Alibaba). These features include customer reviews, ratings, forums and chats that can enable customers' input regarding their previous purchasing experience such as products quality and services received (Hajli, 2015; Liang & Turban, 2011). The interactions among the users may result in discovering products, aggregating and sharing product information, and leading to making shopping decisions (Jia Shen, 2012). The second form of social commerce is embedding commercial activities on SNS platforms (Huang & Benyoucef, 2013). SNS platforms such as Facebook, Instagram and Twitter are used by firms to promote products and brands, communicate with customers, and conclude selling. The platforms allow for efficient socialization between customers and firms, leading to brand loyalty (Zhang & Benyoucef, 2016). Further, SNS connect customers directly with other customers to form a social community. The immediacy provided by SNS allows customers to obtain and share products-related and sellers-related information within their social community. This kind of emerging social commerce is known as i2i (individual-to-individual) or C2C (customer-to-customer) business model (Bao & Volkovynska, 2016), thus, the focus of this study.

C2C-SC refers to social media users (sellers) who use SNS platforms to post products information with the intention to attract other users (buyers) to buy from them. If potential buyers interested to buy the products, they can contact sellers directly to make business dealings that include inquiries on product details, payment methods and delivery methods (Chen, Su, & Widjaja, 2016). The direct communication between sellers and buyers stays in the SNS platforms (i.e. Facebook Messenger) or continues on instant messaging apps (e.g. Whatsapp, WeChat). With regards to business arrangements, buyers can make payments through bank transfer directly to the sellers' bank account or using cash on delivery (COD) methods (Leeraphong & Papsatorn, 2018). The ability to interact directly with sellers and perform various business arrangements (i.e. payment methods, delivery methods) creates unique features of C2C-SC as compared to a traditional e-commerce.

C2C-SC can happen on various social media platforms such as Facebook, Instagram, WeChat and WhatsApp, depending on the popularity of the platforms in a specific region. For example, Facebook is the most popular SNS platforms in the Southeast Asia (Huang & Benyoucef, 2013). This is supported by an empirical study by Talib *et al.* (2018) that discovered Facebook is the most popular SNS platform for online purchasing (78%), follows by Instagram (35%) and Twitter (23%), among Malaysian SNS users. Similarly, in Thailand, Facebook and Instagram are the most popular channels to shop, accounted for 57% and 33.9% respectively (Leeraphong & Papsatorn, 2018).

Regardless of the platforms used, the unique features of C2C-SC inherent some serious issues. Anyone can be a seller on C2C-SC because of the zero-setup cost. Fraudsters, anonymously or even posing as people one's trust, can pretend to be a genuine seller and initiate social relationships and build trust with the intention to defraud their victims. Unlike conventional form of social commerce that developed on a secured platform (e.g. Amazon, Alibaba, Lazada, Shopee), there is no authority or middleman to govern the sellers on SNS. In fact, the loosely way of payment methods, especially a direct transfer to sellers' bank account is a very risky deal. Talib *et al.* (2018) found that 105 out of 332 shoppers on SNS platforms have experienced defrauded, either they never received the products or received fake/misrepresentative products. After realized they have been defrauded, the buyers did not know who to contact to report the events.

METHODS

Procedures

The current study aims for depth understanding in the exploration of the issue; therefore, the number of interviews included in this study was based on the saturation concept. Qualitative scholars suggest diverse factors affecting the number: objectives, nature and scope of study, quality of interviews and interviewers, and sampling technique, among all (Marshall & Rossman, 2014). This study employed purposive sampling, in which participants were selected based on a pre-defined criterion. Participants were identified from two sources: either participants were in a survey conducted by the authors on profiling social commerce shoppers or identified from SNS platforms such as Instagram and Facebook. The main inclusion criteria to be selected as potential participant are that the person must have experience purchasing on SNS platforms. These participants were considered as having unique, diverse, details and important perspective on the phenomenon being studied and in line with the study's objectives, as suggested by scholars (Denzin & Lincoln, 2011; Merriam and Grenier, 2019; Robinson, 2014).

Despite indefinite number of interviews for qualitative studies, Marshall & Rossman (2014) exclaimed estimating sample size could contribute towards theoretical significance and research efficiency. The number of interviews varied and could be influenced by qualitative studies design. For instance, Mason (2010) compiled qualitative methodologists' recommendation of five to 25 interviews for phenomenology study, 30 to 50 interviews for ethnography study, 20 -30 interviews for grounded theory while 15 interviews for all qualitative studies. Nevertheless, Marshall & Rossman (2014) and Robinson (2014) pointed that determining number of cases in a case study is challenging, with scholars recommended at least six sources of evidence (Yin, 2011), or no more than 4 or 5 cases with 3 to 5 interviewees per case study (Creswell, 2007).

For this study, 48 potential candidates were contacted through phone calls and 20 of them agreed to be interviewed. The 20 datasets are considered suffice to address research problems since similar inputs were gathered as the number of cases reached 20. This implies saturation is achieved by 20 interviews. This is aligned with Green & Thorogood (2004) who claimed that nothing new is achieved after completing 20 interviews (Mason, 2010). In line with Creswell (2007), accomplishment of 20 interviews is justified.

Data Collection

With the aim to provide in-depth understandings of buyers' engagement in C2C-SC, a qualitative inquiry was conducted in the study. Semi-structured interviews were conducted that enable participants to share their life experience being the social commerce shoppers. Some participants were interviewed via phone / video calls due to the distance between the interviewer and the participants. Each participant was informed that the interview will be recorded, and they were asked to give their consent to participate. Each session of interview was lasted between 45 minutes and 2 hours.

Interviews were detailed based on the interview protocol. The interview protocol consists of two parts. Part A covers background of the participants. Part B focuses on the main research question on participants experience as shoppers on SNS platforms. The platforms comprise of Facebook and Instagram. This is in line with prior study that revealed these platforms were most prevalent channel to shop online among Southeast Asia shoppers. Further questions were on initiation of participants' engagement in the purchasing process and their purchasing patterns. And finally, participants were asked to unfold the reasons behind their decision to shop on SNS platforms.

Data Analysis

Interview data were transcribed in *in-vivo* form for further analysis. The study employed thematic analysis to analyze the interview data. Thematic analysis from individual cases enables identification of patterns of meaning from the dataset, which are conducted through a rigorous process. In this study, interviews data were analyzed according to stages of data familiarization process, data coding process, formation of themes through searching, reviewing and defining themes process, and finally, writing and contextualizing of themes developed. The patterns of meaning represented by the themes that emerged provide an answer to the research question that explains the phenomenon studied on why people shop on SNS platforms.

RESULTS

Participants

Overall, 20 participants were interviewed for this study with nineteen women and one man. Ages of the participants ranged from 24 to 50. All participants resided in Malaysia. To ensure anonymity of the participants, names have been coded. Majority of the respondents started to shop on SNS platforms since 2010, except for one person. Most popular SNS platform used was Facebook and most common product bought was women's accessories, followed by baby and toys products. In term of frequency of purchase, most of the respondents stated that they bought on a monthly basis and based on promotions. There was one respondent who bought her product every week, as she is online seller herself.

The Perspectives of Shopping on the Social Networking Platforms

Based on the findings, the reasons for buyers to shop on SNS instigated from two motivational perspectives – intrinsic and extrinsic. Intrinsic motivation refers to motivation that comes from inside an individual rather than from any external pressure, which will be able to seek out novelty and extend one's capacity (Ryan & Deci, 2000). The motivation comes from the pleasure one gets from the task itself or from the sense of satisfaction in completing or even working on a task. In the context of this research, we interpret intrinsic motivation as buyers' assessment of the innate rewards (i.e. satisfaction/pleasure, sense

of comfort and convenience) their acquired from buying on SNS. On the other hand, extrinsic motivation is when one is influenced by external forces or factors. In the context of this study, we assume that buyers are interested to buy on SNS because they are influenced by external factors such as inputs from other buyers, the products and sellers' character.

Intrinsic Motivation

In the context of shopping on SNS, buyers' intrinsic motivation to shop can be classified into three themes, which includes *feelings of convenience, comfort and satisfaction.*

Feelings of Convenience

There are various reasons for someone to feel convenience to shop on SNS such as time saving and overcoming distance barrier difficulties. Faced with greater time constraints from work and study commitment, childcare and distance, most of the participants turn to SNS to shop which they found to be more convenience. A working mom, R10, stated that she prefers to browse the internet to look for her things while sitting in the office during her free time rather than spend her time going outside to shop. Another participant said that since she starts working, she has no time to shop in the physical store anymore. Her job commitment impediment her to physically go to the shopping malls, hence she felt more convenience to shop on SNS platforms.

"..I always buy online due to time constraints." (R12)

Time saving does not only benefit working people, but also to housewives. One participant (R14) indicates that with SNS shopping, she does not require much effort especially related to time spending to park her car and also to walk into the store. Saving time is valued very important because she can spend the time to manage her household chores and taking care of her small kids.

"Erm, because a lot of people selling products online and with small kids it is difficult to go out. So online is a good idea; you don't even have to worry about where to park the car and everything." (R14)

In another situation, participants were able to describe why the process of buying on SNS, particularly Facebook, started. For some participants, the turning point to shop on SNS occurred when they moved to remote and rural places due to work and study commitments. In the areas they were located, access to shopping places was very limited and they experienced difficulties to obtain not only personal stuffs but, most importantly, study-related stuffs. Linked to this, the students' busyness with study and the need to obtain tools and gadgets for their study has initiated them to purchase on SNS. In order to solve their problems, they feel more convenience to shop on SNS platforms.

"I have time constraints to go out. I study civil engineering and need to buy all sorts of equipment. There are other things I need to do. During that time, I want to buy a gadget, also a mobile phone to make my work easier." (R19)

Therefore, SNS platforms have revolutionized the ability for buyers to acquire products and services, regardless of location and commitment, to get what they need conveniently.

Sense of Comfort

Some participants feel comfortable to shop on SNS due to changes in commitment. R14 stated that constraints due to family commitment were identified as a reason to shop on SNS platforms. With small kids, she felt more comfortable to shop online from home while taking care of them. Her opinion was shared with R8, who said that it was hard for her to move around to shop with the kids, and hence, online shopping via SNS platforms was the most comfortable way to get her stuffs.

"One of the reasons is that I have a baby. I have a hard time moving around So, I buy online, shopping online. Another reason, it is easy to look for anything, everything is at your finger's tip." (R8)

Furthermore, participants agreed that SNS allow them to shop anytime at their own comfort of time. Normally in SNS, sellers will promote their products and leave their contact number. Since buyers are in the sellers' friend list or fans (likers) of the sellers' business page, buyers can comfortably contact the sellers through communications apps such as WhatsApp or WeChat for business dealings.

"In social media, seller commonly provides their phone numbers in the advertisement of their products. Buyers can then contact them through WhatsApp application based on the contact number given to ask more about the product details and anything." (R9)

Sense of Satisfaction

Based on the findings, a sense of satisfaction was experienced at three levels – before, during and after the purchase. Before the purchase process takes place, participants indicated that SNS platforms allow them to read comments, testimonials and

feedbacks, not only about the product but also the sellers. Ability to acquire more product-related and seller-related information supports individuals to make informed choices which actually increase their satisfaction to proceed to the next level.

For some other participants, their positive experiences while in the purchasing process on SNS platforms triggered their sense of satisfaction. For example, R9 expressing her feeling of satisfaction towards SNS shopping because the platforms facilitated her to search for products that were not marketable at the physical stores or available in limited area only. Others shared those pleasant dealings with SNS sellers leads to satisfaction. The pleasant experience of the shopping has caused them to become addicted to shop on SNS platforms repetitively.

“I have been buying online for many times. All processes went well... So, after few times, I feel good buying from the online platform” (R18)

Finally, a sense of satisfaction was also felt when participants received the ordered products. One female participant described that she feels a sense satisfaction when she received the product on her mailbox, as if she received a gift from someone else. Similarly, R8 indicated that when the product arrived in mail, she become hooked to buy further.

“I feel like I want to buy (laughs)... It’s like satisfaction to know that when you get that item it can be like a gift from someone. Even though we use our own money, we feel like receiving gifts when the items arrived.” (R20)

Consequently, feeling of convenience, comfort and sense of satisfaction formed the internal feelings that motivate social media users to become shoppers. This intrinsic motivation could further interrelate with extrinsic elements that cause buyers to buy from individual sellers in the SNS, as explained in the following section.

Extrinsic Factors

Findings also revealed that buyers’ engagement with C2C-SC was molded by external elements. Based on the themes emerged from data, participants’ decisions to buy from SNS platforms were also influenced by external factors, namely *opinion or inputs of other buyers, sellers’ characterization and products distinct*.

Opinion of Others

Participants’ involvement as SNS shoppers were also influenced by comments, reviews, ratings, and experience of other buyers regarding their interested products and specific sellers. Referring to positive reviews and rating as trusted sellers, for instance, could make potential buyers have confident to purchase from the same sellers. Testimonials with positive reviews and high ratings given by previous buyers could naturally instill trust and lead to prompt purchases. On the other hand, bad reviews and low ratings are used as indicators for risky transactions; hence potential buyers will avoid from dealing with those potentially problematic sellers. However, the trust was not created overnight but it went through a series of process.

“I have been the seller’s follower for quite sometimes before decided to buy from that seller. I read through reviews from other buyers; people commenting on the status, saying thank you and everything.” (R1)

In this instance, the participant becomes the seller’s follower for quite some time first, and then read multiple reviews before deciding to purchase. The good feelings from reviews could change readers’ intention from initially clicking ‘like’ into buying products, due to assumptions that most buyers are satisfied with the services provided by the seller. Often, the participant looks for evidence that the previous buyers did really receive their products and satisfied with the services.

One unique feature of SNS shopping is its ability to allow a group of buyers with the same interest towards a product to form a group, unlike in shopping via online marketplaces. For instance, findings indicate that potential buyers interacting on SNS platforms were able to socialize through WhatsApp or Facebook groups to initiate buying decision. In these special interest groups, buyers shared product details, sellers’ information and their experiences dealing with the sellers. Potential buyers were able to gather information regarding products’ quality, authenticity and delivery services provided by sellers, based on the available testimonials. With sellers’ information in hand, they were able to investigate the background of the sellers before making buying decision. This prudence enquiry is imperative in SNS dealings because transactions are not guaranteed and secured, unlike in online marketplaces.

“Okay, if the seller is established, for example through Lazada, we are able to know the seller, it has guaranteed. But if in the Facebook, the strategy is to check sellers’ background, feedback the seller received before, testimonials or customer experiences in terms of his service and quality of the items. We need to survey first.” (R2).

Therefore, findings indicated that apart from own internal motivation, people could become online shopper due to influence of others. Potential buyers’ decisions could be largely influenced by reviews and testimonials regarding sellers’ reputation and

products quality. Participants also highlighted that pleasure of readings other buyers' feedback on online sellers' services influenced them to buy from the same seller.

Sellers' Characterization

For some participants, what important to them prior to purchasing decision is the sellers' character as portrayed in SNS. In general, the sellers' character could be evaluated based on the way they communicate with buyers, activeness in SNS, frequency of posting of products and quality of services. For instance, one participant explained the process of engaging with sellers. First, the participant often studied the seller's promptness and pleasantness in replying to potential buyers' queries, which deemed crucial. If the participant, being a potential buyer, is happy with the attitude of the seller, he/she will proceed by contacting the seller via social media communication apps. Second, participants also evaluated their own experience interacting with the seller on WhatsApp, particularly related to the time taken by the seller to respond to their messages. These could seriously influence their decision to proceed with the purchase.

"Well, it's good to do background search, look for sellers' details ... See the seller's responses to customer comments, his/her attitude and all about. We need to see that ... If I send WhatsApp message to the seller, I will make sure this person responds to the WhatsApp message quickly. Check if there is bluetick to the message sent. I will not buy if there is no blue tick." (R11)

Furthermore, sellers' active update including their recent status and products postings could influence potential buyers' decision. Their consistent effort to maintain their visibility in the SNS represents the sellers' seriousness and commitment which could enhance buyers' confidence and trust to proceed with the business dealings.

"... haa, so first I will look at the seller's Instagram, the comments and how active the seller reply to customers. Then, how active the status of his/her business or Instagram shops, right." (R15)

At other times, quality of delivery that encompasses transparency and fast delivery, is another aspect evaluated in assessing the sellers' character. Transparent delivery process with tracking numbers informed to buyers could ease products' delivery process. Additionally, receiving items ordered on time would give pleasure experience to buyers in the business dealings and encourage them to continue buying in the future. These efforts represent sellers' responsibility and integrity as social commerce seller.

"It is easy to track the shipment and usually, based on my experience with personal shoppers, there were no problems dealings with them." (R15)

Since the identity of seller could be anonymous in the SNS, their representation as reliable, trusted and committed online sellers becomes a vital influencing element. Therefore, pleasure experiences and satisfactions from successful dealings is an important benchmark for online sellers' services. High quality of services in turns could make buyers more confident to deal with the online sellers and become repeating customers of the social media business.

Product Distinct

One common reason to shop on online platforms, including via SNS platforms, is price. Mohamed et al. (2014) found evidence that good prices offered by online sellers and there was also evidence of this in this study. Most participants claimed that the prices on the online stores are usually cheaper than the offline stores, and hence, motivated them purchase on SNS platforms that provide greater savings. Adding to this, ability to compare prices conveniently online without the pressure to buy contributes to buyers' enthusiasm to shop on SNS platforms. Subsequently, the comparison providing them the best options in buying the things that they are intended to buy.

"So, we compared the price and we found out that the price is cheaper when buying from online... usually cheaper." (R15)

Since SNS platforms are able to attract many online sellers to sell on the platforms, the products choices are also wider and larger. On entering the SNS purchase, participants had felt that the larger selection of products allowed them to get what they needed, regardless of the type of product and motive. In one example, a participant had exhaustively tried to find a rare and unique product for her collection in offline stores, with no avail. When she turned to SNS platforms, the long wanting product was available and this scenario has triggered her to continue shopping on SNS platforms for her rare collection.

"There are many people selling products on Facebook. It is even hard to get the items from outside, so we just buy from online." (R6)

Finally, visceral reaction to the products could also influence buyers to shop on SNS platforms. Visceral reaction can be described as intuitive and instinctive rather than intellectual response (Merriam-Webster's Dictionary, 1999). In other words, people act spontaneously without allowing for cognitive process to take place. In decision to buy on SNS platforms, some

participants were instantly attracted to product images that appear (feed) on their Facebook walls. When further asked why they attracted to the products even though they know they can obtain the same products offline, the responses were varying. One participant claimed that the product looks pretty online and other participants did not know why she was attracted

“Yeah, it is just from the photos (laugh)...The photos that the seller posted looked so attractive compared to others.” (R1)

These findings showed how attachment to visceral elements of products causing the participants to shop on SNS platforms. They unconsciously focus on the physical look (visceral level) of a product than on the usefulness or needs of the product. We can further define these buyers' experiences as impulsive buying. The term “impulse buying” is generally considered to be synonymous with “unplanned buying” which describes any purchase a shopper makes but has not planned in advance (Stern, 1962).

Hence, findings from the study revealed three elements that formed the extrinsic motivation for buyers to shop from the social network platforms. These elements consist of opinion of others, sellers' characterization and product distinct. The interplay of extrinsic and intrinsic motivational elements found in this study revealed the reasons of why buyers commit themselves in the social network business dealings despite of the risks underlying this social commerce atmosphere.

DISCUSSION & CONCLUSION

Findings from this study reveals types of elements obtained from the use of SNS for online shopping, based on customers' own experience. These elements are satisfaction, sense of comfort, sense of convenience, inputs from other buyers, products distinct and sellers' character. Further, the study categorizes those elements into extrinsic and intrinsic motivations that lead users to the platform's choice for online shopping. The importance of intrinsic and extrinsic motivations for shopping over the SNS, offers theoretical contribution that could extend understanding on the selection of SNS as a platform for online shopping. In fact, the findings from this study could potentially extends understanding on the uses and gratifications theory (UGT) elements, beside content and technology (Al-Jabri et al., 2015) and immediate access, leisure, and stylishness (Xu et al., 2012) that affect the motive for SNS usage among online consumers.

This is a first study to identify the reason why people interested to purchase on SNS platforms. While there were various prior studies on factors influencing people to purchase on SNS platforms, most of the study were quantitative in nature and go into little depth about why the shoppers might experience. This study found various experience of shoppers on why they get involve with social commerce, which we categorized into internal and external motivational perspectives. Practically, findings provide indications to online seller community in attracting potential buyers; online buyers on the other hands could justify their reasons for buying online notwithstanding the underlying risks of social network dealings. Theoretically and methodologically, findings emerged from this qualitative study offer in depth understanding of buyers' experience of purchasing through C2C social commerce and provide insightful inputs to the development of SNS business literature.

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Supplier Concentration, Ownership Type and Trade Credit Financing: Based on the Empirical Evidence of Manufacturing Industry Listed Companies in China

(Full Paper)

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ABSTRACT

Trade credit belongs to the scope of supply chain internal financing, which reflects the principal relationship between enterprises and suppliers. Based on the empirical data from a main board manufacturing industry companies of 2008-2018, we examine the influence of supplier concentration on trade credit financing in enterprises with different property rights in this paper. We find that the higher the concentration of suppliers, the less trade credit financing enterprises get from suppliers, indicating that the worry about “fleecing” and similar opportunistic behaviors reducing suppliers’ willingness to provide trade credit. We also find that the negative impact of supplier concentration on trade credit financing of non-state-owned enterprises is stronger than that of state-owned enterprises.

Keywords: Supplier concentration, ownership type, trade credit financing.

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INTRODUCTION

In the early stage of trade credit, it was occupied as an important means of business promotion. In the mid-20th century, based on the doubts about the effectiveness of monetary policy, people began to pay attention to trade credit behavior from a financial perspective. Trade credit is based on corporate credit and obtains free cash flow from suppliers or customers through deferred payment, sales revenue received in advance, etc., which is essentially a financial communication between enterprises within the supply chain. Compared with traditional bank credit, the information advantage between enterprises within the supply chain can reduce the uncertainty and information asymmetry of trade credit transactions, reduce the information cost in the financing contract and the agency cost caused by the principal-agent relationship (Dou & Zhu, 2012). Trade credit can alleviate the financial difficulties of enterprises and improve their operational performance (Shi & Zhang, 2010; Cao & Kuang 2013). Gerard, Teresa, and Ronan (2018) suggested that trade credit has a great impact on the survival rate of SMEs in Europe. A standard deviation of trade credit can reduce the financial distress potential of enterprises by 21%. Therefore, in countries with more trade credit applications, it can be used to make up for the imperfection of the financial credit market (Annalisa & Klaas, 2013).

Currently, trade credit financing is being widely used by companies in many countries around the world. However, the application of trade credit will be affected by endogenous factors and the external environment such as business scale (Wei & Zee, 1997), cash flow volatility and external financing environment (Harris, Roark, & Li, 2019), religious and national culture (Markus Mättö & Mervi Niskanen, 2018), investors’ sentiment (Huang & Bai, 2019), financial credit policy and financial constraints (Hill *et al.*, 2019). Considering that trade credit more reflects the business relationship between suppliers and enterprises, many scholars have studied the willingness of suppliers to provide trade credit financing for customers. Chluddek (2011) proposes that companies with more inventories, larger market share, and economic difficulties provide less supply of trade credit; large companies with sufficient cash flow, high annual sales growth, large export propensity, and high bank credit lines will provide more trade credit. Daniela & Leora (2016) concluded that suppliers with weaker bargaining power would provide a greater proportion of credit sales and longer payment terms. Bank credit constraints would affect suppliers’ provision of trade credit financing. Li & Liu (2016) found that supplier concentration, customer concentration and trade credit financing have different correlations. Sun, Zhai, and Wang (2017) proposed that supplier relations have a positive effect on trade credit financing, and the constraints of industry competition will inhibit the effect. Stanley & Harvey (2018) conducted a research on agricultural products manufacturing, and proposed that the diversification of suppliers’ products, management experience, trade credits obtained from upstream enterprises, and bank overdrafts will affect their supply of trade credit. Zhu & Bai (2018) proposed that supplier concentration is negatively correlated with trade credit financing and studied the impact of non-standard audit opinions and supplier related party relationships on the negative correlation. The above scholars analyzed the factors affecting the supplier’s trade credit provision from the aspects of supplier scale, credit constraints, supply chain cooperation, supplier concerns, etc. Some scholars have considered the role of industry competition, non-standard audit opinions, credit status and other parameters in the model design. Few literatures consider the willingness of suppliers to provide customers with delayed payments when downstream companies are of different nature.

As an easy-to-obtain and low-cost financing method, trade credit financing has a high universality in the financing activities of Chinese enterprises. However, at present, China's trade credit is still spontaneous. Due to the excessive fragmentation of trade credit and the difficulty of supervision, China's trade credit supervision system is incomplete and there are fewer supervision channels, resulting in the enterprise's account receivables being too old and unable to be used. Issues such as recovering bad debts are constantly emerging. The existence of these problems has caused certain obstacles to the popularization of trade credit financing methods. Therefore, under the current situation, it is very important to conduct research on trade credit financing, analyze the impact of supplier concentration on trade credit financing in the supply chain network based on the consideration of the nature of property rights, and find out the corresponding countermeasures.

The historical and institutional background of China's economic development determines the natural advantages of state-owned enterprises in economic transactions, which may lead to differences in the impact of trade credit on different ownership-structured enterprises. Regarding the consideration of the difference in the nature of property rights in the research of supply chain management and corporate relations, Bao & Zhao (2016) found that the concentration of private enterprise suppliers is significantly positively correlated with corporate risk. With the maturity of the Internet platform and the weakening of the enterprise, the positive correlation is relatively weak in state-owned enterprises. Zhou (2017) based on the consideration of the nature of property rights, the study found that when the primary supplier of private enterprises is a state-owned enterprise, the negative relationship between supplier concentration and corporate performance is more significant. These documents have not yet dealt with the relationship between supplier relationships, property rights and trade credit financing. Zhang, Zhong, and Peng (2018) found that compared with state-owned enterprises, there is a more significant reverse "U" relationship between the concentration of non-state-owned enterprise customers and the supply of corporate trade credit. This paper focused on the impact of customer concentration on the willingness of corporate credit supply.

In summary, the literature has explored the relationship between supply chain relationships and business operations or trade credit from different perspectives and also discussed the impact of supply chain concentration on corporate risk and corporate performance for companies with different property rights. At present, the researches on supplier concentration, property rights and trade credit financing are rare. Therefore, this paper takes the 2008-2018 Shanghai and Shenzhen Stock Exchange A-share manufacturing listed companies as a sample to conduct an empirical analysis of the above issues. The aim is to reveal the influencing factors of trade credit financing from the perspective of supplier concentration and try to incorporate the economic effects of property rights into the theory of supply chain relationship management and provide decision-making suggestions for internal financing activities in the supply chain relationship network.

THEORETICAL ANALYSIS AND RESEARCH HYPOTHESIS

Supplier Concentration And Trade Credit Financing

According to the theory of new institutional economics, the more specific the asset investment is, the lower the application value will be in other best uses, which will easily increase the opportunistic risk of contract fulfillment and negotiation. The high concentration of suppliers means that upstream suppliers themselves have more investment in intangible assets related to the establishment of customer relationships. This will lead to an increase in the cost of conversion between the two parties, which will increase the risk of suppliers being "ripped" by customers. As a result, suppliers may lose interest in providing customers with a larger share of trade credit to reduce the chances of customers being squeezed into quasi-rents. Based on the theory of industrial organization, Michael Porter proposed the famous five-force competition model, pointing out that when the cost of switching suppliers is high, its bargaining power is weak. Higher supplier concentration will weaken customers' negotiating ability and companies will be required to pay in advance or be cut off. Suppliers form a strong position in the product market competition, which not only can bring the threat of termination of cooperation to upstream and downstream enterprises, but also impose capital squeeze on upstream and downstream enterprises (Dou, Ba, & Wu, 2014). In addition, the larger the large-scale purchase of the enterprise, the greater the risk that the supplier will bear, and the customer may be required to increase the proportion of the current purchase and reduce the purchase price (Ma, Zhang, & Yi, 2016). Therefore, this paper proposes based on the opportunistic hypothesis:

Hypothesis 1a: Supplier concentration has a negative impact on corporate trade credit financing.

American economist Manco Olson proposed the "free rider" theory in "The Logic of Collective Action: Public Interest and Group Theory". Due to the "free rider" problem, retailers may increase their cash purchases to other suppliers after obtaining trade credit financing, suppliers that provide trade credit bear all the costs but only get a portion of the benefits. Therefore, suppliers who account for a large share of retailers' purchases are willing to provide trade credit (Jiri, Evgeny, & Alex Yang, 2019). That is, when the enterprise purchases from the supplier on a large scale, the supplier will give more purchase credits. According to the theory of price discrimination, monopolistic suppliers often adopt differential pricing strategies in order to obtain excess profits. In order to stabilize the commodity settlement price, the supplier will unify the customer purchase price and impose price discrimination on different customers through the difference in trade credit supply (Schwartz & Whitcomb, 1979). As a result, suppliers will provide large retailers with a large credit share or a longer credit period to hide the information from the sale. At the same time, the stronger the bargaining power of retailers who buy more services from

suppliers, the more trade credits they receive (Giannetti, Burkart, & Ellingsen, 2011). In a collaborative supply chain, the core suppliers will actively develop trade credit financing plans for capital-constrained retailers to motivate retailers to order larger quantities of goods (Dou & Zhu, 2012). Therefore, this paper proposes the opposite hypothesis of hypothesis 1b based on economies of scale and synergistic effect:

Hypothesis 1b: Supplier concentration has a positive impact on corporate trade credit financing.

The Effect Of Property Rights On The Relationship Between Supplier Concentration And Trade Credit Financing

With economy entering into a new normal in China, the nature of property rights plays a more prominent role in the behavior of enterprises. State-owned holding means that the government provides invisible guarantee for state-owned enterprises. Therefore, when the state-owned enterprises deal with small and medium-sized private enterprises, they usually do not need to guard against similar opportunistic behaviors such as “ripping off”. Generally, if there are a large number of related party transactions between suppliers and customers, even if both parties make special investment, they are rarely likely to be locked by partners. According to the relevant statistics of CSRC, compared with private enterprises, state-owned enterprises have more connected transactions. Therefore, if the opportunistic hypothesis has stronger explanatory power, the negative impact of supplier concentration on business credit will be relatively small for state-owned enterprises. Compared with small and medium-sized private enterprises, state-owned enterprises have more abundant resources, more choice space for suppliers, relatively small cost of switching suppliers, and are not easily threatened by suppliers. In addition, the state-owned enterprises have more sources of financing and the willingness to use trade credit financing is not as strong as that of non-state-owned enterprises, so the impact of supplier concentration will also be weak.

On the other hand, as China's economy changes from high-speed growth to high-quality development, the business objectives of state-owned enterprises are no longer limited to the pursuit of performance. When managers make business decisions, they should not only consider the business results, but also bear multiple social responsibilities such as employment and environmental protection. However, private enterprises pay more attention to their business performance and future growth, and their business objectives are relatively single. Therefore, compared with the state-owned enterprises, the private enterprises have stronger motivation to increase innovation investment and enhance competitive advantage by using the synergy effect of supply chain relationship network. There is no doubt that suppliers are more willing to provide trade credit financing to competitive customers. The management defense of state-owned enterprises significantly reduces the quality of information disclosure, while the management defense of private enterprises significantly improves the quality of information disclosure. High quality information disclosure can improve the relationship between supply chain partners, and close cooperation between suppliers and private enterprises will certainly stimulate their willingness to supply trade credit. Therefore, we continue to put forward hypothesis 2 in the form of opposite hypothesis on the basis of hypothesis 1:

Hypothesis 2a: negative effect of supplier concentration on trade credit financing is more significant in non-state-owned enterprises.

Hypothesis 2b: positive effect of supplier concentration on trade credit financing is more prominent in non-state-owned enterprises.

RESEARCH DESIGN

Research Model And Variable Definition

In this paper, models (1) and (2) are constructed to test the research hypotheses mentioned above:

$$TC_{it} = \alpha + \beta_1 TOP5S_{it} + \beta_2 DTA_{it} + \beta_3 CF_{it} + \beta_4 ROA_{it} + \beta_5 GROWTH_{it} + \beta_6 SIZE_{it} + \sum YEAR + \varepsilon_{it} \quad (1)$$

$$TC_{it} = \alpha + \beta_1 TOP5S_{it} + \beta_2 OWNER + \beta_3 DTA_{it} + \beta_4 CF_{it} + \beta_5 ROA_{it} + \beta_6 GROWTH_{it} + \beta_7 SIZE_{it} + \sum YEAR + \varepsilon_{it} \quad (2)$$

Models (1) and (2) are the main models used in this empirical study. In order to control the annual fixed effect, the annual dummy variable is added to the model.

Explained variable

In a purchase transaction on credit with a supplier, upstream and downstream companies often give credit sales quotas based on the business credit of an enterprise, thereby forming a short-term financing of the enterprise, namely trade credit financing. We use the results of “(accounts payable + notes payable) / total assets at the end of the year” to define trade credit financing (TC).

Explanation variables

- ①Supplier Concentration (Top5S). We draw on the definitions in the references to measure supplier concentration (Sun, Zhai, & Wang, 2017). The larger the value of Top5S, the higher the company's supplier concentration.
- ②Owner. According to the definition of the company's actual controller, state-owned holdings take 1, otherwise take 0.

Control variables

With reference to relevant references, trade credit financing is affected not only by the concentration of suppliers and the nature of property rights, but also by other variables. Therefore, the following control variables are defined in this article.

- ①Asset-liability ratio (Dta). It reflects the financial status of the enterprise. In general, companies with low asset-liability ratios have less risk of debt repayment, the company's financial situation is better, and it is easier to obtain trade credit financing. On the other hand, companies with higher asset-liability ratios have greater demand for trade credit financing.
- ②Cash flow (CF). It reflects the situation of the company's capital flow. Generally, companies with better cash flow conditions have lower operating risks and are more likely to obtain trade credit financing. On the other hand, companies with sufficient capital flows may have less demand for trade credit financing.
- ③Return on Total Assets (Roa). It measures the profitability of an enterprise. Generally, companies with high profitability are more likely to obtain trade credit financing provided by suppliers. On the other hand, these companies have relatively little demand for trade credit financing.
- ④Growth. Growth rate of operating income is used to measure the company's growth ability. Suppliers are often willing to support companies with strong growth ability.
- ⑤Company Size (Size). In the definition of variables in this paper, the company size (Size) = ln (year-end total assets). An enterprise's asset size can increase its bargaining power when it expands. It is not easy to be threatened by upstream companies, its debt repayment ability is also high, and it is easier to obtain trade credit.
- ⑥We also set up annual dummy variables to control the impact of the year in this paper.

The names and definitions of variables involved in the model are shown in Table 1.

Table 1: Variable name and definition

	Variable name	Variable code	Variable definition
Explained variable	Trade credit financing	TC	(accounts payable + notes payable) / total assets at the end of the year
	supplier concentration	Top5S	proportion of the top five suppliers' purchase amount to the total purchase amount
Explanatory variable	Property nature	Owner	state holding takes 1, otherwise 0
	asset liability ratio	Dta	total liabilities at the end of the year / total assets at the end of the year
	Cash flow	CF	net cash flow from operating activities of the company / total assets at the end of the year
Control variable	Return on total assets	Roa	annual net profit / total assets at the end of the year
	Growth	Growth	growth rate of operating revenue
	Company size	Size	total assets at the end of the year
	Year	Year	Virtual variable of year, study interval span 11 years, set 10 virtual variables of year

Samples And Data

We select the listed companies of A-share main board manufacturing industry of Shanghai Stock in this paper. The listed companies of A-share main board manufacturing industry of Shanghai Stock Exchange and Shenzhen Stock Exchange from 2008 to 2018 are selected as the initial samples. According to the sample selection rules of most literatures, the following processing is carried out: ST enterprises and * ST enterprises are eliminated, and any value missing samples are eliminated. In order to eliminate the interference of specific value, winsorize processing of 1% and 99% quantiles was carried out for each continuous variable. The sample information of this paper comes from the CSMAR database. Excel 2007 is used for data preliminary arrangement. Stata 12.0 is used for statistical and regression analysis.

As shown in the descriptive statistical results in Table 2, the mean value of TC is 13.51%, the maximum value and the minimum value are 44.65% and 0.75%, respectively, indicating that the business credit scale of different enterprises in this industry is quite different. The average purchase proportion of top five suppliers (Top5S) is 34.82%, which is consistent with the data of existing research. Kong (2011) studied the data from 2001 to 2008, and the average value of Top5S is 39.26%, Lin

(2014) took the data from 2001 to 2011 as the sample, and the average value of Top5S is 30.63%. In addition, the extreme values of Top5S are 91.58% and 6.30% respectively, indicating that there is a large gap in the dependence of different enterprises in the industry on suppliers.

Table 2: Descriptive Statistics

Name	Mean	Std_Dev	Median	Min	Max
TC	0.1351	0.0939	0.1133	0.0075	0.4465
Top5S	0.3482	0.1897	0.3061	0.0630	0.9158
Dta	0.4068	0.2079	0.3965	0.0467	0.9637
CF	0.0425	0.0678	0.0413	-0.1599	0.2283
Roa	0.0441	0.0570	0.0414	-0.1843	0.2113
Growth	0.1907	0.4116	0.1256	-0.5064	2.6647
Size	21.7544	1.1633	21.6183	19.4985	25.2204

EMPIRICAL RESULTS AND ANALYSIS

Correlation Analysis

By observing the Pearson correlation coefficients of 8 variables in Table 3, it can be found that Top5S, CF, ROA and TC have significant negative correlation; owner, DTA, growth and size have significant positive correlation with TC. The results of correlation analysis of supplier concentration are in line with the "opportunism" hypothesis. At the same time, the correlation coefficient of the 8 variables is small, the largest is only 0.4084, far less than 0.7, indicating that the possibility of collinearity among the variables is low. In order to control the interaction among variables, next section will continue to use multiple regression analysis to obtain more reliable conclusions.

Table 3: Correlation analysis results of each variable

	TC	Owner	Top5S	Dta	CF	Roa	Growth	Size
TC	1							
Owner	0.1777*** (0.0000)	1						
Top5S	-0.1325*** (0.0000)	-0.0623*** (0.0000)	1					
Dta	0.4983*** (0.0000)	0.3339*** (0.0000)	-0.1062*** (0.0000)	1				
CF	-0.0454*** (0.0000)	-0.0333*** (0.0000)	-0.0478*** (0.0000)	-0.1586*** (0.0000)	1			
Roa	-0.1435*** (0.0000)	-0.1910*** (0.0000)	-0.0348** (0.0004)	-0.4052*** (0.0000)	0.4189*** (0.0000)	1		
Growth	0.0509*** (0.0000)	-0.0645*** (0.0000)	0.0047 (0.6525)	0.0386*** (0.0000)	-0.0144 (0.1253)	0.2247 (0.0000)**	1	
Size	0.2310*** (0.0000)	0.3049*** (0.0000)	-0.2460*** (0.0000)	0.4084*** (0.0000)	0.0589*** (0.0000)	-0.0295*** (0.0003)	0.0637*** (0.0000)	1

Note: ***, **, and * represent significant at 1%, 5%, and 10% levels respectively; the data in brackets are P values

Regression Analysis

Table 4 shows the regression analysis results of different sample groups. Among them, column (1), column (2) and column (3) respectively report the regression results of the whole sample enterprise group, state-owned enterprise group and non-state-owned enterprise group Top5S and TC, while column (4) reports the regression results of the whole sample Top5S, property right nature and TC.

From the data in column (1) of Table 4, it can be seen that the regression coefficient of Top5S is -0.0436, which is significantly different from 0 at the 1% level, indicating that with the strengthening of supplier concentration, the trade credit scale shows a significant downward trend, and hypothesis 1a is verified.

In order to test the impact of the nature of property rights, we divide the research samples into state-owned enterprise group and non-state-owned enterprise group according to the property rights differences in this paper. The regression coefficients of

the Top5S in column (2) and column (3) of Table 4 are -0.0417 and -0.0444 respectively, and the regression coefficients of the owner in column (4) are 0.0095, which are significant at the level of 1%, indicating that the supplier concentration has a greater impact on the trade credit of non-state-owned enterprises. Due to the natural differences of scale and resources, the financing mode of state-owned enterprises is larger than that of non-state-owned enterprises, and the cost of seeking and replacing supplier resources is lower than that of non-state-owned enterprises. Therefore, the scale and term of delayed payment will be less affected by the concentration of suppliers than that of non-state-owned enterprises. Hypothesis 2a is verified.

According to the data in column (4), it is found that the regression coefficients of the control variables DTA and ROA are both greater than 0, and are highly significant at the level of 1%, which indicates that the debt limit and profit level of the enterprise are high, and the business credit of the enterprise will be more. The regression coefficient of the control variable size is significantly negative at the level of 1%, indicating that the enterprise scale has a reverse effect on the trade credit line. This may be because large-scale customers have a wide range of financing channels, so the demand for trade credit financing is weak. The regression coefficients of CF and growth fail to pass the statistical significance test, which shows that cash flow and growth have no significant impact on business credit. Finally, R2 of the regression model is 0.2846, 0.2233, 0.2866 and 0.2846 respectively, which shows that the goodness of fit of the model is general. Considering that TC will also be affected by many factors such as the length of business operation, inventory turnover efficiency, industry status and national policy, the goodness of fit in this paper is understandable.

Table 4: Regression analysis results

	(1) Full sample	(2) State-owned enterprise sample	(3) Non-state-owned enterprise sample	(4) Full sample
Variable	TC	TC	TC	TC
Top5S	-0.0436*** (-8.65)	-0.0417*** (-3.72)	-0.0444*** (-8.06)	-0.0437*** (-8.56)
Owner				0.0095*** (4.40)
Dta	0.2616*** (44.07)	0.2642*** (21.14)	0.2557*** (37.89)	0.2572*** (42.45)
CF	0.0209 (1.52)	-0.0365 (-1.04)	0.0423** (2.85)	0.02136 (1.37)
Roa	0.1077*** (4.95)	0.1426*** (3.21)	0.1002*** (4.02)	0.1143*** (5.16)
Growth	0.0032 (1.35)	0.0025 (0.48)	-0.0058* (2.23)	0.0024 (1.79)
Size	-0.0047*** (-4.75)	-0.0048** (-2.60)	-0.00630*** (-5.03)	-0.0010*** (-5.29)
Year	control	control	control	control
_Cons	0.1330*** (6.25)	0.1344*** (3.36)	0.1690*** (6.26)	0.0220*** (6.65)
N	7428	2261	5046	7307
Adj_R ²	0.2846	0.2233	0.2866	0.2846
F	226.93***	49.70***	155.51***	207.16***

Note: T value in brackets, * P < 0.05, ** P < 0.01, *** P < 0.001

Robustness Test

We use "(accounts payable + notes payable prepayment) / total assets at the end of the year" to replace the explained variable TC and test the robustness of the regression results of the model in this paper. According to table 5 robustness test data, it can be found that the regression results are consistent with the expectations, and the sign and correlation of each variable are consistent with the regression results in the previous section, indicating that the research conclusions are robust in this paper.

Table 5: Robustness test results

	(1) Full sample	(2) State owned enterprise sample	(3) Non state owned enterprise sample	(4) Full sample
Variable	TC	TC	TC	TC

	(1) Full sample	(2) State owned enterprise sample	(3) Non state owned enterprise sample	(4) Full sample
Top5S	-0.0517*** (-9.70)	-0.0335** (-2.89)	-0.0600*** (-10.08)	-0.0523*** (-9.67)
Owner				0.0109*** (4.75)
Dta	0.2417*** (38.44)	0.2360*** (18.29)	0.2392*** (32.83)	0.2369*** (36.92)
CF	0.0843*** (5.16)	0.0216 (0.63)	0.1093*** (5.93)	0.0828*** (5.01)
Roa	0.0705** (3.06)	0.0962* (2.10)	0.0705** (2.62)	0.0780*** (3.33)
Growth	-0.0002 (-0.09)	0.0010 (0.19)	-0.0024 (-0.87)	-0.0010 (-0.40)
Size	-0.0046*** (-4.46)	-0.0037* (-2.01)	-0.0074*** (-5.45)	-0.0057*** (-5.27)
Year	Control	Control	Control	Control
_Cons	0.1112*** (4.94)	0.0902* (2.19)	0.1720*** (5.90)	0.1312*** (5.62)
N	7428	2261	5046	7307
Adj_R ²	0.2458	0.1868	0.2485	0.2462
F	185.88***	39.70***	128.02***	170.14***

Note: T value in brackets, * P < 0.05, ** P < 0.01, *** P < 0.001

CONCLUSIONS AND IMPLICATIONS

Conclusions

Research at home and abroad shows that as an important partner or stakeholder, suppliers have an important impact on business performance, financial decision-making and risk level. Different from the previous literature, we analyze the economic consequences of supplier concentration from the perspective of trade credit financing scale, and considers the role of the nature of property rights in the relationship between the two in this paper. Based on the information of manufacturing listed companies of a shares in Shanghai and Shenzhen Stock Exchange from 2008 to 2018, we find that the stronger the concentration of suppliers, the less trade credit financing enterprises get in this research. This result more supports the opportunistic hypothesis, which is higher supplier concentration will aggravate the supplier's worry about the opportunistic behavior such as "rip off" and weaken their willingness to provide business credit financing to enterprises. It is also found that the negative impact of supplier concentration on trade credit financing of non-state-owned enterprises is stronger than that of state-owned enterprises.

Implications

In view of the negative correlation between supplier concentration and business credit financing, enterprises should attach great importance to supplier relationship management from a strategic point of view. They should not only maintain friendly cooperation and co creation relationship with suppliers, but also prevent excessive dependence on monopoly suppliers, and increase opportunities for enterprises to be "ripped off" by suppliers. Considering that the negative correlation between the two has a stronger impact on non-state-owned enterprises, private enterprises should make good use of their existing trade credit advantages, increase innovation input, improve competitive advantage and bargaining power, strive to win the right to speak in the supply chain, improve the game ability of enterprises in the supply chain cooperation, and weaken the negative impact of supplier concentration on the business credit of enterprises.

Emphasis on supplier management

Enterprises should pay attention to the management of supplier relationships. Stable supplier relationships can reduce transaction costs for enterprises, but excessive supplier concentration can lead to excessive reliance on individual suppliers, which virtually increases their own operating risks. Therefore, enterprises must not only ensure a stable cooperative relationship with suppliers, but also appropriately reduce the degree of dependence on individual large suppliers to prevent the sudden occurrence of out-of-stock and quality problems of individual suppliers causing problems in their own operations. Improve your bargaining power and avoid accepting harsh payment terms in the face of threats from suppliers. At the same time, according to the full sample analysis results of Shanghai and Shenzhen A-share listed manufacturing companies, Top5S and TC show a significant negative correlation. TCs of non-state-owned enterprises are more susceptible to Top5S than TCs of state-owned enterprises, and the regression results of the relationship between TC and Top5S and the nature of property rights have a high economic significance (P < 0.001). Based on this reality, companies should face up to their position when dealing

with suppliers. When the supplier is in a relatively strong position, the company should not require the supplier to provide excessive trade credit, because the supplier is likely to the cost of excessive trade credit supply is passed on to other related costs. Such behaviors will weaken the cooperative relationship between the company and the supplier, which will adversely affect the company itself.

Focus on improving profitability

Enterprises should improve their own strength and increase the company's profitability. According to the research results in this paper, the Roa index is significantly positively correlated with TC, indicating that enterprises can obtain more trade credit financing under the condition of increasing their own profitability. However, among Shanghai and Shenzhen A-share listed manufacturing companies, there are still many companies with negative Roa, such as -18.43% for Chunlan and -18.39% for Cangzhou Dahua. These negative Roa reflect the poor performance of enterprises in comprehensive utilization of assets. Such enterprises should pay attention to the company's operation and management, control costs, allocate assets reasonably, and avoid problems such as excess capacity. The company has improved the company's profitability, and to a certain extent, it can increase the amount of trade credit financing that it can obtain from upstream companies. At the same time, when the amount of trade credit financing obtained by an enterprise increases, the company can use more liquid funds, which is more conducive to the expansion of production and asset utilization efficiency, and ultimately to the company's profitability.

Maintain proper capital structure

While paying attention to short-term financing obtained from suppliers, enterprises should also pay attention to changes in bank credit policies. In April, the junior high school office and the state-run office put forward further guidance on the difficulty of financing for enterprises. The difficulty for private enterprises to obtain financing from banks will continue to decrease. Broadening the financing channels of enterprises can lay a solid foundation for their long-term development. According to the research results in this paper, Dta and TC are significantly positively correlated, indicating that the proper use of debt financing methods can improve the TCs obtained by enterprises. According to the sample data selected in this article, many companies did not make good use of bank loans, such as Fu'an Pharmaceutical, Xinwei Telecom, and Jiangnan High Fiber. The Dta was only 4.67%. These enterprises operate very conservatively and do not exert the role of financial leverage, which is not conducive to the expansion of production and technology development of enterprises to a certain extent. Such enterprises can properly pay attention to bank credit while seeking trade credit financing from upstream, so that the company can obtain sufficient liquidity and obtain better operating results. Of course, the Dta should not be too high. Too many companies will raise financial risks and increase repayment pressure. Too much interest expenses will also affect the business efficiency of the company. The huge repayment pressure may even cause the company to suddenly die.

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Survival in the digital age – A framework for formulating a Digital Transformation Strategy in SME

(Full Paper)

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ABSTRACT

Many digitally successful companies have established a dedicated digital transformation strategy. An SME perspective on this topic remains unclear. I fill this research gap with a qualitative research approach. Main findings include a set of 14 strategic questions along four summarizing categories – use of technologies, changes in value creation, operational changes, and financial aspects. Three out of these four categories hold true in SME environments as they are valid in large corporation settings. I recommend establishing the term “organizational changes” instead of “structural changes” in order to increase fit to the mindset of SME owners. Answer options enrich these strategic questions, based on the experience of successful examples from the field. I identify differences between SME and large corporations in the areas of value creation, organizational changes and financial aspects. This paper elaborates theory on digital transformation strategy, contributing to understand management behavior and decision levels in an economic environment, where the adaptation of digital technologies has become an imperative.

Keywords: digital transformation, digital transformation strategy, SME, case research.

INTRODUCTION

This study combines the view of SME with existing literature about frameworks to develop digital transformation strategies. I contrast new, cross-sector findings from SME knowledge from previous, single industrial, large company contexts and answer the question: *How does a cross-sector SME context influence core elements of a digital transformation strategy?* Academic groundwork (e.g.: Matt, Hess and Benlian, 2015) has identified core areas affected by digital transformation on a strategic level. By analyzing the digital transformation of selected SME from various industries I show to what extent the same strategic categories are at the center of the digital transformation in SME as it is the case in large companies.

In private as well as in business environments, modes and habits of communication, information, research, as well as simple and sophisticated working processes almost naturally involve the use of hardware and software. There is no doubt that companies must react to the modifications the progress of technologies is causing in society and in their business environments. Technological advancements require existing companies to act in two directions: to adapt their business models, but also to rethink their entire industries (see e.g.: Lucas et al. 2013). *Digital transformation* focuses on change aspects in ways of working, roles, and business offering caused by the adoption of digital technologies in an organization, or in the operations environment of the organization, in order to assure sustainable value creation (Gimpel and Röglinger, 2015).

The academic groundwork of this paper is given by the digital transformation framework of Matt et al. (2015), who developed a generic conceptual model along guiding categories to formulate a digital transformation strategy: *Use of technologies, changes in value creation, structural changes, and financial aspects*. The representative contextual power of these four dimensions was proven for diversified, large scale companies (Hess et al., 2016; Wiesböck et al., 2017). My project eliminates industry specificity by taking a view on digital transformation across sectors.

In order to ensure competitiveness by leveraging digital technologies, small and medium-sized enterprises (SME) must gear up for digital transformation. SME show a range of differentiating organizational criteria that make them merit separate consideration (see e.g.: Carney, 2005). Some outstanding aspects include: (1) *Leadership*: outstanding influence of the company owner on management decisions. (2) *Organization*: owner-manager-centered hierarchical design, role-accumulation, tight personal interconnections across staff. (3) *Production process design*: low degrees of work-sharing, universal machinery, strong dependence on small numbers of basic innovations and low economies of scale. (4) *Sales*: lot-size-one, high degree of customization, limited regional and/or highly specialized segment. (5) *R&D*: no institutionalized R&D department, short-range, highly intuitive R&D activities, limited financial resources, short time budgets from invention to monetization. Around 3.5 million companies in Germany are SME, representing 99.4% of all companies in Germany (see e.g. European Commission, 2015). Together they account for ~2,200 EURbn in annual turnover, representing a share of 34.1% of all companies' value added. They employ more than 15.5 million people, providing a job to 52.7% of the German nation's employment. They all face the challenge to find a successful way of handling the progress of digital technology usage. Based on the large number of SME in Germany, I expect recurring challenges at firms with comparable size, and from comparable industries, giving knowledge about cross-sector digital transformation mechanisms a sizeable audience also from the practitioner community.

From the author's knowledge, digital transformation strategies in SME remain unaddressed in literature. This study fills this gap by relying on a multiple case research design, applied to seven family owned SME from different sectors. All of them are considered typical SME, who have successfully mastered steps towards digital transformation and therefore are rich in information. By conducting open, semi-structured interviews with the seven company owners and members of the management, I provide deep insights. I triangulated the interview data by additional data sources like company websites, social media channels, books written by the company owners, press articles, and financial data. Thereby, this paper elaborates the digital transformation framework of Matt et al. (2015) towards an applicability in situations, where SME owners, independent of their profession, define a digital transformation strategy for their firm.

I find a set of 14 guiding questions a SME owner -independent from sector or industry- can follow in order to define an individual digital transformation strategy along an empirically derived path. Answer options, based on experience of successful examples from the field, enrich these strategic questions. These findings provide a twofold value-added: elaborate the scholar research on digital transformation as well as bridging the gap to practical, all-day business challenges.

BACKGROUND

Digital transformation as a key management challenge

The ongoing advancement of digital technologies provides an unquantifiable number of challenges for businesses of all sizes. It is a sort of "mission impossible" to find a C-level representative from large, publicly listed multinationals, who has not publicly committed to the necessity of a "digital change". Digitization, digitalization and digital transformation have become omnipresent catchwords, often lacking clarity. Scholar literature has tried to ascribe these phrases a unique definition. *Digitization* defines the (pure) technical process of converting analog information into a digital format (see e.g.: Negroponte, 1995). By bringing all types of information down to the lowest common factor, i.e. binary digits, digitization dematerializes information and decouples information from physical carriers and storage, transmission, and processing equipment. This development, in connection with multiple users' wish to benefit from the negotiation and arrangement of the meaning of the bits, set the basis for a need in interoperable standards and common definitions of application and service interfaces (Tilson, Lyytinen and Sørensen, 2010). Therefore, the term *Digitalization* comprises the manifold sociotechnical phenomena and processes of adopting and using these technologies in broader individual, organizational, and societal contexts. Matt et al. (2015) argue that the ubiquity of information technology pushes companies to explore new digital technologies and to exploit their benefits, which involves transformations of key business operations and affects products, processes, organizational structures and management concepts. In order to realize manifold potential benefits like increases in sales or productivity, innovations in value creation, and novel forms of interaction with customers, companies have to open themselves to change, within their own structures as well as beyond their borders (Matt, Hess and Benlian, 2015).

Digital transformation therefore emphasizes the change aspect, i.e. the managed adaptation, focusing on changes in ways of working, roles, and business offering caused by the adoption of digital technologies in an organization or in the operation environment of the organization in order to assure sustainable value creation (Gimpel and Röglinger, 2015). Riasanow et al. (2018), p. 13, define digital transformation "as probabilistic organizational change philosophy where digital technologies are used to fundamentally transform an organization's business model and value network". It is about managing internal efficiency, external opportunities, and additionally disruptive change (Parviainen *et al.*, 2017). It touches a company holistically, including external partners along its supply chain (Bowersox, Closs and Drayer, 2005), comprising the "use of new digital technologies to enable major business improvements (such as enhancing customer experience, streamlining operations or creating new business models)" (Fitzgerald *et al.* 2013, p. 2).

Several experts consider the impact of digitalization similar to the impact of the industrial revolution. Downes & Nunes (2013) describe how entire business models can be reshaped or replaced by what they call "big-bang disruption". Traditional industries or business models like e.g. video gaming, stock exchanges, analogue photography, portable navigation tools, physical book sellers, or physical newspapers can suffer substantial losses of significance or become obsolete, as new incumbents use digital opportunities on supply (company) and demand (user) sides. E.g. Lucas *et al.* (2013) show that the impact of technological advancements requires existing companies not only to adapt, but to rethink entire industries.

Importance of and core elements constituting a digital transformation strategy

Via digital transformation, companies target to compete better by using digital innovations (Main, Lamm and McCormack, 2018). In order to stay competitive, companies must actively manage challenges arising from a deep penetration of technology in their entire business- and operating models. Though the imperative to act is well accepted in general, the execution of digital transformation yields many obstacles. Henriette, Feki and Boughzala, (2015) argue that a digital transformation project involves the implementation of digital capabilities to support business model transformations. They call for collaboration and interaction throughout a company's whole organization, across operational processes, resources, internal and external users, and by this causing major change in employees' habits and ways of working. An explicitly formulated strategy for implementing digital technologies is essential in order to realize the full benefits from digitalization. Less digitally mature organizations tend to focus on individual technologies to solve lone standing problems, whereas elaborate digital strategies guide successful business transformation in most digitally mature organizations (Kane *et al.*, 2015).

Earlier research focusses on IT-strategy, that must be aligned, but subordinate to the business strategy (see e.g. Henderson & Venkatraman 1993), even in an SME context (Hussin, King and Cragg, 2002). However, researchers recently claimed for a new type of digital business strategy, nevertheless struggling how to get there. Bharadwaj et al. (2013) call for an evolution from IT-strategy into a digital business strategy, comprising IT-strategy and business strategy into an overarching phenomenon, which is defined as an organizational strategy formulated and executed by leveraging digital resources to create differential value (Bharadwaj et al. 2013, p. 472). Others demand for a standalone digital-edge strategy, taking into account the specific nature of SMAC technologies, incorporating digital and physical resources, and concentrating on specific business outcomes rather than grand strategies (McDonald, 2012). Both viewpoints agree urging for an integrated view on business and technology in the light of digital transformation, but they remain unclear about how to incorporate actions on the actual transformation steps. Furthermore, as it has been shown that not all digitalization that is possible is desirable, e.g. due to negative effects of transparency towards competitors (Grover and Kohli, 2013), companies need to consider an individual optimum of digital infusion to their business strategy.

Scholars have identified necessary strategic actions in digital transformation, thereby laying the ground to develop industry specific frameworks for the configuration of a digital transformation strategy. A case of a digital business strategy for online music content providers fosters the call for an integrated view on business and technology on a company strategy level (Oestreicher-Singer and Zalmanson, 2013). Further case study-based articles discuss guidelines for digital business strategies and organizational implications with a special focus on publishing and newspaper industry (see e.g.: Øiestad & Bugge 2014). Results indicate the necessity to entrench elements of exploitation and exploration into a company's digital transformation strategy, next to necessary innovation capacity and capabilities like resources, processes, and values. An imperative to include inter- and intra-company organizational change aspects in a digital transformation strategy can be derived from a case study from the retail industry (Hansen and Sia, 2015). An example from a toy producer lists distinctive characteristics of business strategy and business model, an enterprise platform, necessary mindset, corporate IT, and workplace environment necessary in order to create digital leadership (El Sawy *et al.*, 2016).

The digital transformation framework by Matt et al. (2015) represents a clear step towards a holistic approach for the construction of a digital transformation strategy. It claims that every digital transformation endeavor should be structured along four, well aligned key dimensions (Matt et al. 2015, p. 340-341): 1) *Use of technologies*: a company's strategic position and future ambition towards new technologies, as well as its ability to exploit them. 2) *Changes in value creation*: the influence of digital transformation on the way, a firm aims to add and create value. 3) *Structural changes*: modifications in a company's operations, i.e. structures, processes, and skill set. 4) *Financial aspects*: deliver transparency about the urgency to act in the face of declining margins in a firm's core business, and about a firm's financial scope to invest in a digital transformation endeavor. These four dimensions have been explored by scholars, taking a case based view on diversified media companies (Hess *et al.*, 2016) and medium to large scale insurance companies (Wiesböck *et al.*, 2017). While in both studies, the strategic configuration especially of the "use of technologies", "structural changes", and "financial aspects" dimensions show potential for generalization, the designs of the "changes in value creation" dimension -not surprisingly- does not allow for any transfer of conclusions across sectors. Furthermore, small companies and their specific attributes are excluded from any investigation so far.

Due to their special attributes, a plain analytical transfer of existing knowledge around digital transformation strategies to SME is not permissible.

RESEARCH DESIGN, SAMPLE, AND METHODS

Research design

I apply a case based research design that "investigates the contemporary phenomenon in depth and within its real-life context" (Yin 2014, p. 16). Units of analysis are digital transformation mechanisms in SME. Within a narrative section, I describe the cases in order to give the audience context, stories and meanings in order to promote understanding of each case's situation. Meanings and patterns are elaborated using an abductive approach.

Sample

I purposefully chose selected examples of SME, who successfully mastered digital transformation. The scope of digital transformation as the investigated phenomenon is not limited. All cases stem from the German skilled craft sector, a unique German phenomenon, that is not clearly delimited as a business sector, comprising services and manufacturing goods providers. 94 professions belong to the skilled craft sector, being listed in the German "Trade and Crafts Code". Based on an evaluation of the employee numbers across the sector I consider craft businesses typical representatives of SME. Together with technological consultants from the chamber of skilled crafts for Munich and Upper Bavaria I selected outstandingly successful examples of digitally transformed SME, who's actions "permit logical generalization and maximum application of information to other cases [...]" (Patton 1990, p. 182). In order to identify those critical cases, I used different preselection criteria (see e.g.: Miles, Huberman and Saldaña, 2014). The sample SME must have fully or partially transformed their business- and/or operating model. As a basis for judging the relative degree of digital transformation in their respective fields, IT was used (a) for fundamentally altering traditional ways of doing business, or (b) to dramatically change how tasks are carried out and therefore is recognized as being important in enabling the firm to operate (see e.g.: Lucas *et al.*, 2013, p. 372). Sampling continued until no new insights emerged from additional case analysis, meaning until theoretical saturation was reached. The final sample consisted of seven cases, all located within a radius of 80 kilometers around Munich, Germany. In order to allow

for an acceptable degree of generalizability across the SME sector, I chose an industry-spanning approach. Table 1 gives an overview of the seven case companies under analysis.

Table 1: Overview of Cases under analysis

Company (Crafts)	Carpenter	Denturist	Electronics technician	Electronics technician	Joiner	Metalworker	Tailor
Abbreviation	A	B	C	D	E	F	G
Core business	Woodwork	Dental technology	Industrial-fire prevention technology	Capacitive and optical sensor technology	Woodwork	Metal construction, plastics injection molding	Textiles
Number of staff	~20	~40	~20	~130	~35	~30	~5
Founded	1995	1981	1997	1983	1999	1985	1961
Target market	Germany	Germany	Worldwide	Worldwide	Europe	Germany	Germany
Principal client relation	B2C	B2C/B2B	B2B	B2B	B2C	B2C/B2B	B2C/B2B
Organizational scope of digital transformation	Processes	Products and processes	Products and processes	Processes	Processes	Processes	Products and processes

Data sources

Main source of data were semi-structured, open interviews with owner managers of the selected SME. When the owner manager suggested to include additional knowledge carriers (e.g. children working in the company or co-managers), I always agreed. The number of interviews I conducted in each firm ranged from one to three. Overall, I conducted 11 interviews, which is more than in previous studies (Hess *et al.*, 2016; Wiesböck *et al.*, 2017). The interview data was triangulated based on availability by further sources of information, e.g. the firms' websites, brochures, social media activities, books, financial data, or guild information materials. I also asked accompanying junior researchers to write down their impression, providing a common understanding to formulate each company's case report.

Data analysis

The interviews were recorded, transcribed and coded. I applied first cycle coding methods labeling the data blocks (Miles, Huberman and Saldaña, 2014). Then, I adopted second cycle coding methods in order to group and summarize the initially found first cycle codes into "a smaller number of categories, themes, or constructs" (see e.g.: Miles et al. (2014), p. 86). Emerging pattern codes laid the basis for cross-case analysis. From the first case, an initial SME digital transformation framework was developed. Following, I examined successive cases to see whether new patterns found match the findings from previous cases or increase variance (Yin 2014; Miles et al. 2014, p. 103).

In order to ensure a satisfying degree of transferability, case reports provide thick description. Validity and reliability in coding are supported by a three stage process proposed by Campbell et al. (2013), where I as a senior coder at start identified blocks of meaning in the interview transcripts. I gave the so-called unitized data as well as the first version of the codebook to a junior coder in order to redo the coding. After this, we compared our codes, which resulted in an inter-coder reliability of .74 on concept-level, .75 on theme-level, and .82 on dimension level (Campbell *et al.*, 2013; Miles, Huberman and Saldaña, 2014). After discussing and negotiating the results as well as eliminating ambiguity, inter-coder reliability reached 1.00 on all pattern levels.

CASE DESCRIPTIONS

Carpenter (A)

A is family-owned and was founded in 1995, currently employing ~20 people. The main business is custom-made woodwork. From start, innovative production technologies were a central element in the company founders' investment activities, targeting to simplify processes and reduce production costs. The firm's strategic focus lies on private upmarket customers with a demand for high quality individualization. The automatization of production processes based on cutting-edge numerical control (NC)-machinery, able to fulfil highest requirements in the elaboration of complex geometries, helped to meet increasing customer requirements. For visualizing complex, personalized products, CAD programs are in use throughout the sales process. Considering its location in the countryside, the firm in recent years strengthened its capabilities around online customer interaction by combining a website, built according to customer feedback, with a structured online marketing approach.

CAD usage and the frictionless integration of automated production via computerized NC machines led to successful positioning in high quality, high margin sector. Being among the firsts to use these techniques in classical woodwork gave the company a competitive advantage. Highly elaborate, digital sketches including inherent NC-production-programs represent a marketable product on their own, creating an additional field of revenue. Due to the high degree of automation, the company realized efficiency gains, based on reductions in waste, increased quality, and the ability to employ lower skilled people in production. To replace mailings and newspaper advertisements, a new website was launched in 2015, which is constantly

updated based on customer feedback. In parallel, A started to make use of search engine optimization (SEO) and search engine marketing (SEM). Whereas sales and customer base are increasing, the marketing budget was reduced by 80%.

Denturist (B)

The owner manager founded company B in 1981. With a yearly turnover of ~1.5 EURmn, the company employs ~25 people by manufacturing dental prostheses. It combines traditional dental with digital technologies. The company started digital transformation in 2002, when the owner bought the first automated milling machines for dentures. Then, as now, competing companies still traditionally produce dentures with a lot of manual effort. In order to achieve highest accuracy, the company since a decade relies on natural tooth recording using intraoral 3D-scanners, a *modus operandi* still ahead of industry standard. Based on digital scanning and modeling, the move to automate production appeared logical. Recently, the company digitally addressed office support processes and invested in digital proposal generation, order management and e-invoicing. Digital transformation is driven by the owner manager's fascination with the opportunities that digital technology offers across the entire value chain. He constantly observes the market for innovations around his core business, but also strives to leverage his company's capabilities and capacities even beyond.

The firm sees digital technologies as enabler of business goals and to remain one of the leading dental technology laboratories. Throughout its existence, the company was able to enhance its client base constantly by offering high quality dentures at lower cost in a shorter range of time. B's owner has developed several innovative production techniques, incorporating 3D-printing, and milling. This enabled the firm to work with non-standard materials and enabled additional products like drilling templates for dentists. B, based on own patents, sells self-developed techniques to other companies worldwide. The deep penetration of digital technologies in the value chain allowed to increase quality, reduce costs by almost eliminating defective goods, and speed up production processes.

Electronics technician (C)

C is specialized on automated firefighting solutions for industrial machinery. Founded in 1997, today it employs ~20 people in Germany and ~10 in China to serve worldwide clients. Products are customized to client needs and offered including installation and maintenance, being constructed for spatial limited areas in machines. Digital transformation was a reaction to fast corporate growth and incorporated organizational challenges. C's industrial customers requested firefighting devices to be implemented in automated production lines already in planning and construction phases. Therefore, the company developed necessary digital interfaces. Resulting remote maintenance services are now offered additionally to the regular service portfolio. All customer communication is enabled digitally incl. electronic billing. C owns a data base covering all historical installations. Thereby, physical maintenance works at clients' sights, causing costly production outages, can be planned with a high degree of precision, including necessary parts and actions. This led to quality and efficiency improvements of products and services. At the time of this study, the firm is in the latest development stages of a completely new product family, based on the digitalization of industrial fire prevention.

The newly innovated, digitally enriched product will set a new industry standard regarding reaction times and integration in digital machinery environments. The company expects to benefit from tighter strategic alliances with its current as well as new customers. Also, C is increasing its efficiency due to comprehensive reduction in manual office work as well as digital tool usage in preparation of assembly and installation processes. Employees, based on the cloud database, digital part lists and office workflow management, can use travelling times more effectively. While in earlier years billing took several months, as technicians are on assembly for several weeks in a row, billing is now executed within days.

Electronics technician (D)

D is a world market leading producer of sensors for various fields of applications. Based in Munich, it owns branch offices in China and the USA. Core products are capacitive level sensors and optical sensors, which the company develops and produces tailor-made for its B2B client base. The firm, founded in 1983, is family-owned with ~120 employees. Due to its core product focus on sensor technology and constant R&D activities, working with digital technologies always was part of D's DNA. Customers request the firm to stay at the edge of digital developments with respect to products and processes. On the product side, the firm engages in the internet of things (IoT), developing sensors, which can communicate among each other as well as among a network of machines. On the process side, D has introduced a new enterprise resource planning (ERP) system with a customer interface, so that customers can place their orders directly within the company's order management system. Feedback from customers is given via a one-click feedback system, thereby creating an early warning system for potential process threats. Being in a knowledge driven industry led D to implement a comprehensive, yet easy to use, social-media-like internal communication platform and included knowledge management system. An automated database using text blocks was introduced in order to avoid extensive editorial work when creating user and production manuals. As the company is active globally, social business networks play a major role to communicate with partners and customers.

High customer centricity involving digital technologies has led the firm to conquer a niche market and to develop its unique selling proposition. The ERP-integrated order management helped to reduce office work and to avoid recurring mistakes due to manual data handling. Automated billing will be the next step to realize an order execution without manual interference. In order to tighten customer relationships, D is participating in the creation of a platform based B2B web shop, incorporating partner companies and allowing business customers to order integrated solutions online.

Joiner (E)

E's owner started the joinery with three employees in 1999. Today the firm employs ~30 people. It remains family-owned and serves the European market, focusing on production and distribution of woodwork with linoleum surfaces. At the time the owner started E, market situation was difficult caused by high competition. In wish for flexibility in personal life and less market pressure, the owner decided to leverage technological options he had in his manufacturing site, specializing his product portfolio on tables with linoleum surfaces. Based on first market success of the product, customer demand, and opportunities of e-commerce, the company opened its first web shop in 2005. Since then, E strives to use innovative technology to distribute products in a convenient, customer-centered manner, e.g. via an online 3D-configurator and integrated live chat function for direct customer interaction. Relying on online sales as single distribution channel included investments in SEO and SEM. In order to streamline the order execution process, E introduced a product-data management tool, which interconnects order entry, production terminals and customer communication.

The interplay of a highly specialized product portfolio, automated cutting, milling and finishing machines in production, and online sales, led the company to conquer a niche market. The company's expertise regarding user experience and technological capabilities around its web shop provide competitive advantage. The high degree of automation throughout the production processes yields efficiency gains. By avoiding manually caused information gaps as well as defects, customer rejects and waste were minimized. The employment of lower skilled people in production led to decreasing labor costs.

Metalworker (F)

With ~30 employees, F, since 1985, is focused on the individual development and production of special purpose tools via metal and mold construction. Furthermore, it produces specialized parts for bicycles and bicycle trailers, and engages in plastic injection molding.

F's owner and management ascribe digital technologies a support function. In order to reduce the workload of office employees, e.g. taking calls by customers regarding orders and special requests, the company created its own web shop. As demand for plastic injection molding and customer requirements in this area have increased over the last years, the firm in this business field applies material handling via robots as well as digitally supported production planning.

The establishment of the web shop enabled higher sales as well as increased efficiency regarding office work. The automated production processes in plastic injection molding leveraged productivity, whereas product quality became better and output has increased.

Tailor (G)

G was founded in 1961. Being originally a toll manufacturer for leather goods, the present owner, the founder's son, created his own collection of traditional costumes and fashion. With currently ~5 employees, the company produces traditional dresses, high quality clothing for motor cyclists, and technologically enriched special clothing. Motivation for first steps of digital transformation came from customer requests 10-15 years ago. Out of a scientific project, the company was asked to combine textiles with sensors in order to document motions of the wearer. This newly gained knowledge today is used to enlarge G's product portfolio. The firm develops and distributes functional work fashion incl. sensors, e.g. to measure vital signs and environment data. As a basis for all products, the company relies on customer satisfaction and good quality. Defects are repaired in-house in order to gain knowledge and to improve new products. Due to concerns around quality and theft of intellectual property, the company only makes little use of digital technologies in production. Only standard sewing patterns are digitally exchanged with outsourcing partners, all critical expertise is kept in-house.

Proficiency in digital technology handling enabled G a position as preferred partner of various institutions and business partners, incl. universities, scientific institutes, and large corporations, when it comes to digitally enriched clothing and wearables. In order to gain financial and structural headroom for further R&D and product innovations, the company currently separates its wearable solutions business from the core business, traditional and biker clothing. Vision thereby is to improve the life of customers along their daily routines by a useful combination of digital technology and elaborate artisanship. Nevertheless, by exploiting light templates in combination with laser cutting, G was able to leverage quality and profitability of traditional products as well. ,

GUIDELINES FOR FORMULATING AN SME'S DIGITAL TRANSFORMATION STRATEGY

The following section unfolds a decision framework in the form of strategic questions, each enriched by answer options company owners can choose from in order to structure individual digital transformation journeys. The basic structure was provided by the four dimensions of the Digital Transformation Framework (Hess *et al.*, 2016). Summarizing tables of all dimensions can be found in appendix 1 to 4.

Use of Technologies dimension

The adoption of information technology across the company depends on the importance the owner ascribes to their usage. A general level of ambition lays ground for the intensity of technological penetration throughout the firm.

Question 1: How significant is your firm's IT to achieve strategic goals? The importance firm owners ascribe to the strategic necessity of adopting digital technologies shows great variation across the various companies. Opportunities as well as strategic imperatives dictated by clients are seen from different perspectives. Some firm owners consider IT to be an enabler of strategic goals. By actively absorbing digital technologies, they see new business opportunities arising. Being an enabler urges a firm to constantly observe the digital future and screen the market for technological advancements, e.g. in collaboration with

scientific institutions. In contrast, other firm owners ascribe IT a support function to reach their strategic goals. In this latter case, digital technologies drive market developments, urging companies to adopt to a changing environment in order to stay competitive. Firms with a supporter lens screen the technological landscape for sources of improving their operations or aligning their processes with clients' value chains.

Question 2: How ambitious is your firm's approach to new digital technologies? In SME, technological ambition of the company owner is crucial for organization's openness towards digital advancements. Thereby, individual ambition is independent from the strategic role of IT as labeled in question 1, as personal experiences of the company owner, existing capabilities among the company's employees or among firms' networks, the financial situation of the company, or the risk-taking appetite as well as some inventive genius are more decisive factors. While cautious company owners may in general trust on well-established technologies with a proven record of accomplishment and reliability, more curious and entrepreneurial minds might strive to dive deeply into new technological developments. Those firms who are at the forefront of innovating new technologies are labeled innovators. They search for cutting-edge technology, regarding their products and services as well as with a view on their operations. Companies, who are not engaged in this fundamental style of research but see opportunities from being the first ones to apply new sorts of technologies to their individual field of business, are named early adopters. They actively screen the market for recent developments, in their own field as well as in other sectors, and try to exploit them as early as possible in their own field. The most conservative firms, called followers, rely on well-established solutions, which have already been applied in similar environments and to similar challenges. Motives of the firms' own accord mainly arise from the wish of leveraging efficiency across processes; external triggers are mainly customer requirements.

Changes in value creation dimension

Defining the model of value creation is the most severe task for the owner of a company. As digital technologies have proven to revolutionize competitive landscapes within a few years, a digital transformation strategy must target the mode of generating revenue, sources of efficiency, and the constitution of a firms' value network.

Question 3: How can your firm digitally leverage sales? The ubiquity of the internet accompanied by IoT technologies are changing purchase and sales processes in both, B2B as well as B2C relationships. It is an important task to define the role of digital channels in market positioning. Firms need to define how digital their interface to customers and their interaction to potential buyers should be, a crucial point in an SME environment where often there is no sales team, but instead company owners and their office support staff do sales. The cases imply that online presentation of products and services on the company's website or via social media channels is an imperative, independent from the target customer base. B2C as well as B2B focused companies all try to be present online at least with a website, but also using private and business social media sites. The same holds true for product sale via web shops. The decision for direct online sales is more dependent on the type of products offered, market dynamics and current and future customer habits than on the target customer base. Sophisticated online responsiveness labeled as the ability to enter in a mutual dialogue with the customer, using the website or social platforms as a trigger, is mainly deployed by B2C focused firms. This is also the case for the engagement in SEO and SEM. Both are only practiced by selected case companies after thorough investigation of the impact of their marketing budget allocation.

Question 4: How can we adapt our product portfolio? Digitalizing the product portfolio and thereby exploiting opportunities for new sources of revenue creation is a crucial task within a digital transformation strategy. It yields the chance to stay competitive and to differentiate against competitors. Digital technologies can become components of products themselves, but they can also be utilized in the development and production of analogue products to create competitive advantages. Furthermore, the case companies leverage options for individualization and standardization. Digital production techniques and data analytics allow the realization of so far impossible geometries in production, as well as digital simulation and calculation of products and services, and thereby facilitate an offering of client-individual customization via design and functionality. On the other hand, digitally enriched and data driven production processes reveal the feasibility of using identical parts or materials in situations where customers do not value manually enabled individualization.

Question 5: How can your firm increase the efficiency of its processes? Five out of seven cases under investigation mentioned that usage of digital technologies is mainly seen from a standpoint to increase efficiency throughout process operations. Only companies B and G tended to see digitally enabled product adaptations as their key focus, despite also exploiting digital technologies throughout their operating models. Main source of efficiency improvements across the cases is the substitution of manual production steps by automated production, thereby realizing speed advantages. Nevertheless, superior quality of goods by reducing rejects, trash and processing time is always seen in combination of seeking speed advantages. To realize the full speed and quality potential of digital production facilities, all cases benefit from a major shift in craft process operations. Traditionally, the usual, time consuming mode of operations was to program necessary metrics into every single machine on its own, which is now done centrally and only once. Another source of efficiency is the reduction of average wages in production by employing lower skilled people who need less training and experience for the handling of digital machines in contrast to manual material treatments.

Question 6: How can your firm leverage efficiency across its value network? All company owners see digitally facilitated or enabled vertical and horizontal partnerships along their value chain as a key factor of success in digital transformation. The internet, simplified methods of data processing, and communication via mobile tools make inter-company cooperation more efficient or even possible, as new partners can be identified via internet and social media research. Some cases use outsourcing in production, enabling an efficient allocation of technological production capabilities across the value chain, e.g. a focus on the production of selected goods, preliminary production steps or focus on design and on-site assembly. As conceptualization and realization of website design and updating as well as a firm-tailored IT infrastructure are considered rather complex tasks, all cases outsource website programming and hosting, operational systems programming, and IT services. Companies C and D are connected to their customers via electronic data interchange (“EDI”) interfaces, allowing them an automated exchange of product and process data with their customers and contributing to a favorable strategic position, based on tight digital and processual integration. Some innovator companies struggle that key partners do not understand the favorable impact of their products, processes and services. Therefore, both pursue the technological education of key business partners, aiming for tight interaction and realizing joint digital progress.

Question 7: Where is it an option not to engage in digital transformation? It revealed to be interesting where leaders in digital transformation see potential analogue hideaways in contrast to digital imperatives. Usage of digital communication channels is considered an absolute must. The same holds true for the implementation of digital production technology. However, the company owners admit that not everything that can be handled digitally must be handled digitally. In case of proven economic disadvantages like insufficient quality of automatically vs. manually crafted products, permanent resistance from the staff leading to processual distortion, or a high risk of knowledge theft, some company owners decided to omit digital potentials. Still, almost all company owners state that some persistent advantages they draw from technology usage would not have been possible without failure, so a general “refusal of digital” is not considered a viable decision option. At last, customer requirements may slow down digital transformation as they require paper-based exchange of information.

Organizational changes dimension

Going through a digital transformation requires a company to reconsider its organizational structure. Firms must define responsibilities, decide about the appropriate entity structure, plan on how to realize a necessary employee structure and how to ensure that a required skill set becomes integrated to the firm.

Question 8: Who is in charge of the digital transformation endeavor? A specialty of SME is the centralization of leadership where the company owner mostly plays the strategically decisive role. When it comes to digital transformation, most cases show a joint responsibility of the management team in decision making. In four of the cases, the management team consists only of family members; two cases have a person in charge of the position of technical director, comparable to the role of a chief technology officer. In all cases with a team approach, the mode of operation is that one dedicated member of the team is responsible for making suggestions towards technological improvements, but final decision and execution are taken care of as a team.

Question 9: Do you plan to integrate new operations into existing structures or to create separate entities? In the execution of digital transformation, some company owners reach a seminal moment, where they ask themselves about the strategic relationship between their traditional and their future business models. Across the case companies there where two decisive factors that bring along the strategic question of how to arrange the future company structure. At first it can occur that new business operations require technologically skilled employees like engineers or IT specialists, who tend to earn a lot more compared to previous employees. At second, necessary investments tend to raise considerations around financial resources and the incorporated risk profile of the company.

Question 10: What types of operational changes do you expect? Being able to react and adapt requires a clear understanding of expected changes that digital transformation will cause across own as well as contiguous industries. The most important area of change is seen in the improvement of business processes, where incremental developments in the future are expected at an even more intense level than today. Mainly affected are production and office related areas, where e.g. the use of workflow management systems, product data management systems as well the integration of NC programming and production still yield a lot of headroom for improvement regarding usability and customizability to individual requirements of businesses. Along come expectations around a new set of required skills based on digital technologies. In all areas of the firms, employees will need at least a basic understanding of digital tools. A third aspect of expected change concerns products and services. The firms agree that classical craft products will remain also in a digitalized world, but clients' expectations regarding quality, design, and delivery times will increase due to the exploding number of design and functional options, logistics, and digital production techniques. Besides, digitally enriched products are expected to see considerable market growth.

Question 11: How can your firm realize a target employee structure? As most of the case companies expect a changing skill set among their staff, the acquisition of necessary competencies is seen of major importance. All firms agree that two modes must go together. On the one hand, the companies must develop their existing staff by fostering general willingness to develop additional knowledge. On the other hand, all companies agree on the long-term necessity of attracting young employees, so called digital natives, to push digital transformation. Thereby the formal qualification, e.g. in a certain skilled craft, steps back against the digital affinity and knowledge of digital tools of applicants. Hereby, all cases see a positive side effect of being a

digital leader. Whereas many companies generally complain about the scarcity in skilled workforce, the companies under investigation consider their reputation as a clear advantage in this war for talent.

Question 12: How can you personally acquire necessary competencies and inspiration? The ability to assess technological advancements requires the company owners to be familiar with major technological developments in their fields. All cases show that mastering digital transformation requires both, formal competencies as well as the inspiration to transfer them to their traditional craft business models. Since both go hand in hand, there is no difference between the options where to obtain them. Internally, company owners source their knowledge from regular feedback, given by their staff. External sources for expertise are evaluated by the case companies purposefully on an implicit cost-benefit-basis. All cases consider the chamber of skilled crafts a valuable source of knowledge but vary in the intensity of usage. Some rely on the consulting services of selected experts, whereas others regularly take part in information sessions. Other options to obtain external knowledge and impulse are voluntary, self-organized experience exchange groups, or trade fairs, where company owners search for products and machinery augmenting their sources of value creation, in addition to meeting clients and highlight their own developments. A last option to capture external knowledge are specific vertical networks, including e.g. practitioners from related industries, and scholars from academia.

Financial dimension

Most of digital transformation efforts require significant investments, e.g. in assets, human capital, but also R&D. The case companies ascribe 30-70% of their total yearly investments to digital technologies. They also agree on an implementation and learning time of at least one year until positive effects from digital transformation components are realized. Therefore, a solid financial structure is critical. At the same time, eroding margins in traditional core business areas may trigger company owners to consider steps towards increasing efficiency or exploiting new revenue sources. To finance all endeavors, different sources of capital are worth evaluating.

Question 13: How strong is the financial pressure on your current core business? If primarily analogue business models continue to deliver sufficient profits, many company owners neglect the necessity for digital transformation. When margins start to plunge, it may be too late. Therefore, company owners should carefully evaluate their whole product portfolio based on the inherent financial pressure, i.e. the ability to deliver stable or, at best, increasing margins. As soon as they see signs for margin deterioration, action becomes an imperative. For SME, this aspect becomes even more important due to limited economies of scale. Four of the seven case companies see a major threat for themselves as well as other craft businesses, when industrial players enter competition with small-capacity craft businesses, e.g. based on technological advancements that enable lot size one without profit limitations.

Question 14: How will you finance the digital transformation endeavor? Financing digital transformation activities remains a tough question for SME, especially as limited financial resources are one of the key characteristics. In general, due to limited size and recoverable assets, banks remain reluctant when it comes to lend money, especially for digitally ambitious endeavors without proven economics. Still, most cases under investigation see a mix of internal funds from cash flows and loans by their house bank as sufficient. Additional equity financing to fund digital venture ideas is only considered by one firm owner. The rationale is the lack of openness and understanding of his house bank for innovative business ideas, accompanied by own risk considerations to secure the persistence of traditional business. Therefore, the owner sees no alternative than using all financing options possible for gaining headroom for incremental growth, especially private equity in the form of venture capital and crowdfunding. Wherever possible, all companies have already applied for public funds, e.g. economic development programs, subsidized loan programs, or research funds.

DISCUSSION

Confirmations and differences from existing findings arise on three levels: the *style* in which SME owners tend to think about the development of their business compared to employed managers, relevant *categories* to be covered, and around the *options* company owners can choose from in order to individualize their digital transformation strategies.

SME owners think in a selected *style* about the formulation of their individual digital transformation strategy. This holds true across all categories but becomes obvious when defining aspects of future value creation and organizational aspects. It appears that SME owners tend to define a strategy for their firm highly realization focused. This is indicated by the fact that they ask themselves e.g. "How can my firm digitally leverage sales?" and see the options "Present products on website or in social media", "Establish web shop", "Engage in Search Engine Optimization/Marketing", and "Communicate with customers online". They also ask, "How can my firm adapt its product portfolio?", potentially with "Fully digital products", "Production techniques/ patent usage", "Individualization", and "Standardization". I find that SME leaders take a multichannel perspective as well as a limited number of potential optimizations in their product offering for granted and set this knowledge in the context of their business. Results from larger corporations tend to be contradictory. While findings from media industry are in line with my results (Hess *et al.*, 2016), findings from insurance industry indicate that the decision options towards a digital sales channel transformation is not predetermined between analog/physical (Wiesböck *et al.*, 2017). Dissociated from any industry specificity, SME leaders seem to sacrifice some degree of freedom in their decision making towards the scope of their digital transformation in order to gain focus on the realization of benefits.

The general architecture of the digital transformation framework (Matt, Hess and Benlian, 2015) is corroborated by this study. *Use of technologies*, *changes in value creation*, and *financial aspects* remain top-level strategic dimensions valid for SME. This fortification shows the theoretical suitability of the construct to analyze digital transformation on a common ground. Regarding applications in practice, this finding indicates that practitioners can define digital transformation strategies with at least an acceptable probability to succeed for various companies on the common ground of the proposed categories. Nevertheless, in order to increase fit with the driving thoughts of the owners of the companies under analysis in this study, I suggest to introduce an “organizational changes”-dimension instead of a *structural changes* dimension. In their initial framework, Matt et al. introduced “structural changes” referring to “variations in a firm’s organizational setup, especially concerning the placement of the new digital activities within the corporate structures” (Matt et al. 2015, p. 341). While I agree on the importance to assign responsibilities, organizational positioning of new activities, focus on operational changes and the development of competencies, I see these aspects in an SME context affecting structural as well as operational aspects. As SME show differential structural characteristics compared to larger corporations, operational and human centric aspects like employee structure or business network of the owner manager gain higher importance compared to formal responsibilities and compared to the integration of new operations in the firms’ structures. The term “organizational changes” incorporates more emphasis on human factors in the conception of a digital transformation and therefore provides a better representation of the SME context.

Regarding strategic questions and options within the overall four categories of the digital transformation framework, I find three categories to be influenced by the SME environment. Only the *use of technologies* category, defining the importance a company is placing on IT in general, and its technological ambition, proves valid also for the seven SME companies in this study, as it has done for media companies (Hess *et al.*, 2016) and insurance companies (Wiesböck *et al.*, 2017). As this fact confirms the generalizability of the digital transformation framework as a theoretical construct, it points out an essential acknowledgment for the management practice in digital transformation: ascribed significance and ambition by either company owners or managers form the basis of success in digital transformation throughout every business environment.

The category *changes in value creation* is strongly influenced by the SME setting. I find five strategic questions SME owners ask themselves around the future scope of their value creation metrics. The structure of these questions represents a comprehensive toolbox where digital technologies support the management of SME to strengthen elementary parts of their business model. This comprehensiveness has not been identified within specific industrial, large corporation environments. Digital transformation strategies in the media industry are limited to transformations in sales, product offering, and resulting future main business scope, neglecting an efficiency perspective (Hess *et al.*, 2016). Large insurance franchises cover aspects of operations and efficiency next to sales, product offering and new sources of revenue creation and ask for the future main business scope (Wiesböck *et al.*, 2017). Covering and bundling those same aspects, the SME perspective I present is less differentiated based on its industry-neutrality. New questions from the SME perspective arise in two fields. Firstly, SME owners strive for inter-company efficiency by trying to leverage efficiency across their entire value networks in collaboration with suppliers, partners and clients. Secondly, they urge to become indispensable partners for their clients by getting connected to them via automated interfaces or engage in the technological education of their business partners. Another SME specialty is depicted by the option not to engage in digital transformation.

Having elaborated on the term organizational changes in the contrast to structural changes before, I find SME influence especially on the content level of this category. The owner manager himself together with his management team always takes the responsibility for transformational actions. There is no C-level structure of responsibilities as seen in large company environments (see e.g. Hess *et al.*, 2016; Wiesböck *et al.*, 2017). SME always take steps of digital transformation based on an integration in existing corporate structures. Only in the case of highly ambitious initiatives, SME consider founding new legal entities. In this perspective as well as in the focus of expected operational changes, there is no difference in the findings on SME compared to larger corporations. Further differences arise from the operationalization of competency building. Large corporations from media and insurance industry take a portfolio management approach towards competency building, incl. takeovers and external sourcing (Hess *et al.* 2016a; Wiesböck *et al.* 2017). SME focus only on two areas of actions: they develop their existing staff and are eager to attract young, digital affine talent. It is in the particular interest of SME owners to find ways to personally acquire the necessary knowledge about digital technologies. Taking their own responsibility for the firm for granted, they consider proficient knowledge around future developments driving their business as mandatory and evaluate multiple options for knowledge generation. Surprisingly, research on large corporations neglects this aspect.

Finally, this study extends the financial aspects category from the SME perspective. SME owners as well as corporate managers examine the margin development in their core business areas in order to prioritize the necessity of investments in digital technologies. When it comes to financing, SME differentiate more sources of capital in comparison to large corporations, incl. public funds. External equity financing and crowdfunding remain niches, but still observable.

CONCLUSION, CONTRIBUTION, AND LIMITATIONS

This study extends previous work on digital transformation strategies in specific industries, all conducted based on case studies of large corporations, to a cross-sector SME setting. I show that the general categories along which SME and large corporations structure their digital transformation endeavors do not differ widely. “Use of technologies”, “Changes in value

creation”, and “Financial aspects” are useful categories to serve companies of all sizes. The SME perspective adds some options on the detailing level. While large companies additionally focus on structural aspects in their digital transformation, I ascribe the term organizational aspects better fit to the conceptual considerations within SME. The absence of hierarchy between categories points out complexity and multidimensional nature often ascribed to digital transformation.

For the analysis, I have chosen a clearly defined segment of the German economy, covering about one million SME. Collaboration with technology experts of the chamber of skilled crafts guaranteed access to the firms under analysis, yielding reliable and unbiased data. With the number of seven cases, I more than double the sample size of comparable studies in large corporations. Picking up skepticism about external validity of case-based research in general, seven cases out of one million is far from being representative. This study claims transferability to the context of heterogeneous challenges SME face when dealing with explicit or implicit thoughts of strategy development towards digital transformation. There is a need for more research to ascertain whether the findings of this study can be more broadly generalized. Further investigation should focus on whether the questions found can be confirmed within SME different from the skilled crafts sector, including businesses from other countries.

Focusing on examples of successful digital transformation in SME, the emerging patterns must be interpreted within the limitations of a cross-sectional, exploratory research design, particularly its inability to determine directions of causality. Though I used triangulation to find publicly available evidence for the owner manager statements gathered in interviews, it is not clear e.g., whether process efficiency improvements were intended, or whether they can be ascribed to the inventive genius of an individual in combination with a trial-and-error process. Future research might analyze digital transformation from a longitudinal, process-oriented standpoint or incorporate management control systems research to find out whether success in digital transformation endeavors is controllable. The results of the present study can also serve as a promising point of departure to investigate the mid to long-term (non-)financial benefits from digital transformation. Based on observations during my visits at the companies’ facilities I speculate that leaders in terms of technology absorption tend to be successful also in economic terms. Nevertheless, publicly available data was not sufficient to provide any assertion on that topic. Digital transformation is a long and multilayered development with many outside and inside variables SME owners must consider. The given results aim to support SME owners and managers to motivate themselves and their staff to get inclination and inspiration for a productive way to deal with digital opportunities. By addressing this issue with a structured approach, results shall help to overcome obstacles, avoid mistakes and therefore perpetuate businesses.

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Appendix 1: Digital transformation strategy – Use of Technologies

Strategic Dimension	Strategic Question	Strategic Option	Description	A	B	C	D	E	F	G	Highlighting Examples	
Use of technologies	How significant is your firm's IT to achieving strategic goals?	Enabler	IT is an enabler of strategic goals		x	x	x			x	B: Digital technologies lead to cheaper products at higher quality. D: We always think from the clients' perspective [...] and actively foster their technological advancements	
		Supporter	IT is seen as a support function to reach strategic goals	x			x	x	x		A: Digital transformation is mandatory. Without digital processes, we would be out of the market. F: We see digital transformation just as a measure to save costs and lighten our processes	
	How ambitious is your firm's approach to new digital technologies?	Innovator	The firm is at the forefront of innovating new technologies			x					x	B: If we are not on the forefront of innovation, our partners are not interested in a cooperation anymore. G: The question was what could we do with circuit boards; why not put them into clothes?
		Early adopter	The firm actively looks for opportunities to implement new technologies	x		x	x	x				A: We already started using CAD-programs in the year 2000, when this was far from standard. Same with CNC production machines. C: We saw that this technology will become standard - so why not be among the first users?
		Follower	The firm relies on well-established solutions							x		F: We include digital part tracking systems, if our clients want it; not because we consider it necessary.

Appendix 2.1: Digital transformation strategy – Changes in Value Creation (1/2)

Strategic Dimension	Strategic Question	Strategic Option	Description	A	B	C	D	E	F	G	Highlighting Examples	
Changes in value creation (1/2)	How can your firm digitally leverage sales?	Present products on website or in social media	Company uses website and/or social media as a digital showroom	x		x	x	x	x	x	A: Three years ago, we decided to set up a new website. Today we have an enormous digital interaction with our clients. F: It is so easy to show pictures that are seen by clients, who decide "I want the same".	
		Establish web shop	Sell products via own or platform-based web shop				x	x	x		D: We are engaged in the establishment of a sole B2B solutions platform where customers order system components as a package. E: We are only selling our products online, there is no offline purchasing.	
		Engage in SEO/SEM	Company uses SEO/SEM for marketing purpose	x			x	x	x		A: We reduced our marketing budget by 80% with replacing printed products by a structured, self-administered SEO/SEM approach E: With a little creativity, we manage SEO/SEM successfully without great financial effort	
		Communicate with customers online	Company wants to enter a mutual dialogue with the customer, using website or social platforms	x			x		x		A: We see many product requests coming in via our Website. The dialogue via digital channels gets more and more intense. D: In an international context, business oriented social media is the best option to start relationships with new partners and customers.	
	How can your firm adapt its product portfolio?	Fully digital products	Sell elaborate digital design/production plans or software tools	x								A: Many people made us do the design and then went away to have it realized by a competitor, causing loss via wasted time for us. Now we are selling the digital planning and design of our product, independently from the realization, so we do not have to care whether we get the final order or not.
		Production techniques/patent usage	Sell innovative, patented production techniques		x							B: We developed this utility model some time ago. Now a US industrial corporation is using it and I am participating in their turnover at 5%.
		Individualization	Digitally enabled customization via design or functionality	x	x		x	x		x		B: We are best in the interpretation of x-ray and other digital pictures. For every implant, we can deliver an individual drilling template. E: As craftsmen, we are used to lot size 1, digital techniques enable us to realize it efficiently at higher scale.
		Standardization	Automated production where customers do not value manually enabled individualization	x				x				A: Clients do not care about plug drill holes, so in NC production we standardize it. E: Our whole business model is focused on products with low complexity, so we only have to alternate design and size.
	How can your firm increase the efficiency of its processes?	Reduce manual tasks	Realize speed advantages of automated production vs. Manual production	x	x	x	x	x	x	x	x	B: We have clients all over Germany; they just send us the data and we start production without necessity of manual modelling. F: We invested in the latest robot technology for reducing manual work steps.
		Superior quality of goods/services	Reduce trash, reduce processing time	x	x	x	x	x	x	x	x	C: We maintenance and resulting down time of our clients at a much more detailed based on data from our automated database. D: Automated troubleshooting & control steps reduce the human factor as source of failure.
		Shift effort from operations to production planning	Centralize NC-programming efforts in production	x	x	x	x	x	x	x	x	A: We shift time towards preparation of production and client advisory; but production itself and assembly work much faster. E: All stations of production are computerized. Based on the data of our web configurator, we send the production program to all machines.
		Use data for process optimization	ERP, operational data collection, one-click-feedback			x	x					C: Our products have Ethernet interfaces, enabling us to offer remote service, and to improve products, production & assembly processes constantly. D: We use web-based ERP and other software for process optimization.
		Increase speed in communication	Use digital tools (cloud access to databases, platforms, route planning) for internal communication				x	x			x	C: Our staff is away from the office for weeks. Via cloud access, they do time recording constantly, which enables us to send invoices within 1-2 weeks. D: We have a lot of knowledge within the company; emails are often deleted without being read, so we use a platform for sustainable knowledge sharing.
		Employ lower skilled people in production	Reduce average wages in production	x								

Appendix 2.2: Digital transformation strategy – Changes in Value Creation (2/2)

Strategic Dimension	Strategic Question	Strategic Option	Description	A	B	C	D	E	F	G	Highlighting Examples	
Changes in value creation (2/2)	How can your firm leverage efficiency across its value network?	Outsourcing in production	Efficient allocation of technological production capabilities across value chain, e.g. focus on production of selected goods, preliminary production steps, or design and on-site assembly	x	x			x			A: Suppliers do windows and doors today. B: For other laboratories, we do the milling, because they <u>to</u> not own the necessary machinery. E: Competitors have become clients.	
		Outsourcing of program-ming/IT	self-explanatory, incl. IT conceptualization	x	x	x	x	x	x	x	B: Our management software is developed and hosted by a partner company, who works for other craft businesses as well. E: For IT conceptualization and programming we work in tight relation with a partner.	
		Use standard interfaces for automated data exchange	Automated ex-change of product or process data between company, suppliers, or customers				x	x				C: Our electronic machine plans can be integrated in customers' production planning tools. D: We use EDI interfaces to our important customers, so they can place orders directly into our order management tools.
		Technological education of business partners	Tight interaction between company and key business partners for joint digital progress			x				x		B: We offer apprenticeships for future dentists, so they understand what we do and why we do it. G: At the beginning, we were just involved in projects for sewing. Now we have the knowledge on technology, so we teach the engineers in team works.
	Where is it an option not to engage in digital transformation?	Never with regard to communication	Communication to customers or partners via website, email, social media etc.	x	x	x	x	x	x	x		B: One click - and insurance companies and doctors receive the correct data set based on our own production data E: Amazon et al. set the standards - we need to keep in touch with our customers, updating them on their order progress
		Never in production	Digital production technology	x	x			x	x	x		A: For us as a production-oriented enterprise, digitalization in production is necessary; otherwise, we cannot stay competitive. F: Digital supported cutting becomes the new industry standard, we have to stay competitive.
		In case of negative economics	Proven economic disadvantages (incl. high risk of knowledge theft) or no impact of digital technology on craft	x	x					x	x	A: Especially if you are a small business, you have evaluate carefully potential benefits of digital technologies. F: I put digital cutting data in the hands of unreliable foreign production partners, there is a high risk of my data getting stolen.
		In case of customer requirements	Customers require paper-based exchange of information, e.g. due to missing interfaces or not suitable processes			x		x				B: We send an electronic invoice, but our customers call and say: Please, we need a paper-based invoice with the delivery note. D: Digital invoicing technically is not a problem, but some customers require it for documentation reasons.

Appendix 3: Digital transformation strategy – Organizational Changes

Strategic Dimension	Strategic Question	Strategic Option	Description	A	B	C	D	E	F	G	Highlighting Examples	
Organizational changes	Who is in charge of the digital transformation endeavor?	Joint responsibility of management team	Management team as a whole	x	x	x	x	x	x		A: We have separated responsibilities among the management, but decisions for transforming actions we always take together. C: There is a technical director in charge of technological developments, but strategic decisions are taken among the whole management team.	
		Owner manager	Owner manager of company							x	G: I am the one responsible for digital transformation. The others are not interested in these topics.	
	Do you plan to integrate new operations into existing structures or create separate entities?	Integrated	Digital operations are fully integrated into an organization's current structures - default setting	x	x	x	x	x	x	x		A-F: The legal entity structure is determined by other considerations than digital advancements
		Separated	Digital operations are implemented separately from the core business		(x)						x	G: We are just about to found a separate entity for our technology topics; especially from a liability perspective there is no alternative. (B): We have some developments in our pipeline. Maybe one day we will found a separate entity for their realization.
	What types of operational changes do you expect?	Business Processes	Improvement of business processes	x	x	x	x	x	x	x		B: Costs are lower; quality is higher with increasing use of digital production techniques. D: There are still so many processes involving paper and manual actions that can be digitally optimized.
		Skills	A new set of skills based on digital technologies		x	x	x	x	x			D: The usage of digital communication tools becomes mandatory; it must enclose non-digital as well as digital natives. F: The orchestration of sales via digital platforms, using digital CRM, will require other profiles than our current sales force.
		Products and services	Changed products and services	x	x	x		x		x		A: Clients' expectation increased due to exploding numbers of design & functional options. B: The handling of many new materials is enabled via digital production techniques.
	How can your firm realize a necessary employee structure?	Develop existing staff	Foster employee's general willingness to develop additional knowledge	x	x	x	x	x	x			A: Our staff acquires relevant competencies via education, mainly by the manufacturers of our machinery. D: The advent of digital technologies does not necessarily require new people; but some activities are added to existing jobs, becoming daily routine.
		Attract young/digital affine employees	Attract young employees to adapt digital technology - also without formal qualification	x	x	x	x	x		x		B: We do many things in an individual way, so digital affinity and curiosity are more important than traditional, manual proficiency. C: External expertise helps analyzing own habits and find innovative solution.
	How can you personally acquire necessary competencies and inspiration?	Regular feedback from staff	Self-explaining			x		x				C: We sit together once a month and discuss opportunities for improvements; the people who work outside in the field have good ideas. E: Our team meets weakly and we collect ideas, besides giving feedback and discussing other topics of importance.
		Professional associations	Chamber of skilled crafts, guilds, etc.	x	x	x	x	x	x	x		A: Companies organized in guilds typically are well informed on future developments, via information materials, training courses, etc. A-G: Technology experts of the chamber of skilled crafts help us, e.g. regarding public funding options, patent handling, events on digital topics, etc.
		Experience exchange groups	Voluntary networks with other company owners from same industrial background	x		x						A: We visit operating sites of the involved partners twice a year, and see how machines and programs work, and get inspiration. C: It is a group of machine tool manufacturers. We sit together and sometimes I get inspired for new products.
		Visit trade fairs	Self-explaining	x	x		x	x				A: Sometimes we see a new machine on a fair and think what we can do with it. B: It is important to visit some fairs, look around and talk to people on opportunities and market developments.
		Vertical network	Voluntary networks across industries, incl. practitioners and scholars		x		x		x	x		D: For research and development we work in some university projects. F: We just developed a new product cooperating with a scientific research institute.

Appendix 4: Digital transformation strategy – Financial Aspects

Strategic Dimension	Strategic Question	Strategic Option	Description	A	B	C	D	E	F	G	Highlighting Examples	
Financial aspects	How strong is the financial pressure on your current core business?	High	Digital technologies erode margins	x						x	A: In some core products, prices are declining since years without a perspective of bottoming up. F: There is a lot of competition; by working through the weekends, we were able to be profitable at yearend.	
		Medium	Digital technologies affect core business margins, but the core business remains profitable	x	x							A: In other products we see declining margins due to investment necessities - if you start with digital technologies, you have to do updates regularly. B: We see margins declining, but slower than expected.
		Low	Margins in the core business remain mostly unaffected by digital technologies									
	How will you finance the digital transformation endeavor?	Internally	Finance digital transformation through internal funds	x	x	x	x	x	x			B: We fund all our year-round investments from our cash flow. F: We went the classical journey via our house bank and cash flow financing.
		Public funds	Publicly supported funding	x		x	x	x	x		x	D: We receive publicly subsidized loans via our savings bank. E: The "Digitalbonus" helps; this public grant backed half of our investments.
		Externally	External equity financing necessary to finance digital transformation								x	G: We have to use all financing options possible for gaining headroom for incremental growth, e.g. private equity in the form of venture capital.
		Crowdfunding	Self-explaining								x	G: Being innovative in financing issues is as important as being innovative in product development. That is why we also use crowdfunding.

The Influencing Factors on Consumers' Purchase Intention under the Cross-border E-commerce Platforms

(Full Paper)

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ABSTRACT

The purpose of this paper is to explore the influencing factors of consumers' willingness to purchase in the cross-border e-commerce websites and apps. We believe that the most significant factor affecting consumers' cross-border online shopping is online trust. Therefore, this study divided online trust of cross-border e-commerce platforms into four dimensions, and extracted four independent variables which are perceived usefulness, perceived easy to use, perceived security and consumers' trust propensity according to the TAM theory. Moreover, we used consumers' online trust as a mediator variable, constructed an expanded TAM research model to explore the mechanism and determinants of consumers' cross-border online shopping. Finally, the conclusions and implications were given according to the empirical analysis.

Keywords: Cross-border E-commerce, purchase Intention, TAM, online trust, influencing factors

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INTRODUCTION

China's cross-border e-commerce industry has demonstrated stable and rapid development thanks to the implementation of appropriate policy support and the progressive establishment of e-commerce platforms. The industry's prosperity suggests unique advantages of cross-border e-commerce, which are a result of promoting industrial transformation and accelerating economic restructuring.

In July 2018, Premier Li Keqiang of China's State Council announced a new initiative to upgrade China's Opening Up policy; boosting cross-border e-commerce and upgrading foreign trade. Building on previous experience, China's trade departments and city-level government aim to streamline approval, upgrade administrative procedures in logistics and storage, and speed up customs clearance. It will further facilitate international trade, stimulate business innovation, and encourage healthy competition. More zones will boost the volumes of imports and expand the range of competitive foreign products available to Chinese consumers.

According to iiMedia Research, Chinese cross-border e-commerce transactions reached 6.7 trillion yuan (\$1.01 trillion) in 2016, and increased significantly to 7.6 trillion yuan in 2017. The overall transaction scale (including retail and B2B) was growing considerably and jumped to 9 trillion yuan in 2018.

There are different platforms popular among Chinese consumers with different challenges and benefits. Kaola.com. Tmall, the giant of e-commerce, JD, Little Red Book, Yangmatou, Wechat store etc. On the retail sector, where new business models help retailers and suppliers meet the ever changing and demanding needs of retail shoppers. One example of this business model innovation is multi-sided digital platforms, which have become popular as they connect consumers with suppliers from around the world with a large ecosystem to support the retail platform.

Chinese government agencies have introduced a number of policies in support of rapidly growing cross-border e-commerce to promote China's international trade. Reducing transaction costs by means of policy intervention could generate comparative advantages and contribute to the growth of international trade.

As e-commerce is steadily increasing every year, trust building has become an important research topic in e-commerce research especially in developing countries. Some scholars pointed out that trust in intermediary and trust in online sellers are separated. Antecedents of trust and trust transference between online sellers and the intermediary are also explored.

This article presents a model based on Technology Acceptance Model(TAM) and an exhaustive examination of the model which is used to analyze the impact of online-trust on cross-border online purchase intention, and particularly research that addresses the four impacting factors of online trust of cross-border e-commerce. Consumer online trust is an important construct that has been frequently studied in the e-commerce literatures. Online trust is typically conceptualized as a mediator in research models between selected antecedents and consequences. Antecedents of online trust are studied to determine the extent to which they influence online trust. Consequences of online trust are studied to determine the extent to which online trust influences consumers' intention to use, use, or continue to use an e-commerce website.

Moreover, cross-border online transactions are more complex than domestic online transactions. Therefore, inconsistent results

create a quandary when attempting to generalize the existence, nature, and magnitude of online trust-related relationships. This study examines the antecedents and consequences of consumer cross-border online-trust in China. We built a cross-border online purchase intention model based on TAM model which considered online-trust as a mediator variable and other four variables as antecedents. Four antecedents are perceived usefulness, ease of use, perceived security and trust propensity.

CONCEPTUAL MODEL AND HYPOTHESIS DEVELOPMENT

Conceptual Model

There are many research papers that analysed influence factors of consumer online trust to explain consumers' willingness to purchase, such as websites or apps factors (security, ease of use, etc.), business factors (size, reputation evaluation), consumer factors themselves (trust propensity, online shopping experience) and trading environment (ethics, information technology). But there is no study based on the systematic and basically model to analyse the purchase intention of consumer through cross-border e-commerce websites or apps in general.

Although sales growth suggests that the number of online consumers is growing, diverse research findings do not conclusively determine which online shopping attributes influence consumer attitudes towards online shopping. From the perspective of customers' purchase intention, there are some mainstream theories, such as theory of reasoned action (TRA), theory of planned behaviour (TPB), technology of acceptance model(TAM), theory of customer perceived value maximization etc.

The technology acceptance model (TAM) provides a conceptual framework for the study of users' willingness. TAM suggests the belief–attitude–intention–behaviour causal relationship for explaining and predicting technology acceptance among potential users. TAM proposes that two beliefs about a new technology, perceived usefulness and perceived ease of use, determine a person's attitude toward using that technology, which in turn determine their intention to use it. Perceived usefulness is the degree to which one believes that using the technology will enhance his or her performance.

Based on TAM, this paper adopt perceived usefulness, perceived ease of use, perceived security, and trust propensity as the independent variables, online trust as the mediator and purchase intention as the dependent variable. And then we constructed a model of cross-border online shopping intention model.

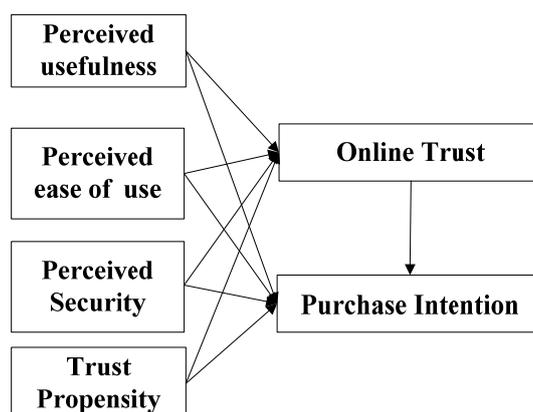


Figure 1 Conceptual model of the purchase intention

Perceived usefulness is defined as the subjective probability that a user improves their work performance in an organizational environment due to the use of a technology application system. In online cross-border shopping, perceived usefulness refers to the extent to which consumers perceive the use of cross-border online shopping to increase the output of their purchases. Compared to traditional international trade methods, the network can provide richer product information, reduce shopping costs, reduce shopping time, provide 24-hour service and enforce the controlling force that consumers perceive during the cross-border shopping process.

In the technology acceptance model, perceived ease of use is defined as the degree to which users can easily use the technical system without trouble. In cross-border online shopping, ease of use means that consumers perceive cross-border online shopping convenience and believe that shopping on the network can take less effort. It will make customers feel convenient through effective interaction between buyers and sellers, clear and easy-to-understand trading interface, convenient ordering and fast payment method. In general, when individuals feel that the difficulty of adopting a new technology is higher, the possibility of using this technology is lower, therefore consumers are willing to accept and trust such shopping only when they feel that cross-border online shopping is the easy way.

Perceived security is an expectation of safety and privacy of customers' personal funds, information and other aspects of cross-border online transactions. Because of the virtual nature of cross-border online purchase, consumers have great concerns about the security of trading and information transmission through the internet. There are some determinants which can affect consumers' trust in cross-border online shopping, such as the credit card information during the transaction, the security of

funds during the process of transaction, the protection of the user's personal information and privacy, etc. Moreover, there is a very significant factor whether the products received are consistent with the commitment of the online seller after payment. Cyber security issues can cause customers to worry about the loss of their personal and financial information when they are compromised on the cross-border e-commerce websites or apps, which can affect their decisions of purchase online. Previous technical acceptance model research has found that the impact of consumer perceived security on cross-border online shopping intention has become an important factor in consumers' acceptance of cross-border online shopping.

Trust propensity of customer can affect the consumer's purchase intention and actual decision, in addition to common demographic variables such as gender, age, occupation, education and income level. Trust propensity is a willingness to rely on other people because of different education backgrounds, personality types, and growing environments of individual. In cross-border e-commerce, consumers' trust propensity tends to have a direct impact on online trust which has been confirmed by some research papers.. Consumers' trust propensity is the kind of their personal characteristics, and a person with a high level of trust propensity is more willing to trust others than that of low level.

With a plethora of cross-border e-commerce websites and apps that consumers can choose from, online trust has become an important construct to investigate in the context of e-commerce purchase intention. Online trust is generally regarded as reliance on a specific firm by its stakeholders with respect to the firm's business activities in the electronic medium generally, and specifically on its website.

Consumers' online trust plays a significant role in the customer's purchase intention. Firstly, the formation of consumer online trust is based on the long-term repeated purchase of customers on the cross-border e-commerce websites and apps. Secondly, customers' online trust is relied on the word-of-mouth of their circles of friends. Therefore, customers in the cross-border online shopping situation who are affected by the subjective norms can form an initial trust in the purchased websites or apps. When the initial trust is continuously strengthened by the surrounding influence, the consumer's online trust will be strengthened.

A large number of studies have shown that improving and resolving network security perception will also have a positive impact on trust generation; while consumer security perception is generated, consumer network trust will also occur. In the cross-border e-commerce environment, online trust is an important factor affecting behaviour of consumers. Moreover, relevant research showed that in the online cross-border shopping situation, the consumers' online trust is positively related to their purchase intention, which can lead to repeated purchase behaviour. In summary, it can be inferred that factors will affect their network trust, and thus affect their willingness to purchase through the channels of cross-border e-commerce, such as perceived usefulness, perceived ease of use, perceived security and trust propensity.

Hypothesis Development

Online trust can positively influence consumers' willingness to purchase based on cross-border e-commerce websites and apps. That is, for cross-border e-commerce websites and apps, online trust of consumer will increase the willingness to purchase cross-border online products.

First, people tend to use an application of cross-border online shopping to the extent they believe it will help them perform their purchase better. We refer to this first variable as perceived usefulness. Second, even if potential users believe that a given application is useful, they may believe that the systems is too hard to use and that the performance benefits of usage are outweighed by the effort of using the application at the same time. That is, in addition to perceived usefulness, usage is theorized to be influenced by perceived ease of use. Perceived usefulness is defined here as the degree to which a person believes that using a particular system would enhance his or her purchase performance. This follows from the definition of the word useful which is capable of being used advantageously. Within an organizational context, people are generally reinforced for good performance by raises, promotions, bonuses, and other rewards. A cross-border online shopping website or application in highly perceived usefulness, in turn, is one for which a user believes in the existence of a positive use-performance relationship.

Online shopping website or application should be designed to be easy to use and have good functionality. The structures of the product display and the tips of website and apps will have significant impact on the trust of consumers. The consumers' perceived usefulness and perceived ease of use are constructed by the elements of the design, merchandise display and search fluency of these specific cross-border e-commerce websites and apps.

No one would argue, we think, perceived security of cross-border e-commerce websites and apps is the influencing factor that really affects the consumers' online trust.

From the consumer's personal point of view, personal traits are a long-term stable feature that is not easily changed by the environment. The personal trait of consumers is generally measured by the consumer's trust propensity. This paper also believes that the personal traits of consumers are the antecedent of consumer trust. Consumers who have high level of trust propensity should have high level of online trust in cross-border e-commerce websites and apps. The eleven hypotheses developed according to our concept mode are as follows:

H1: Perceived usefulness of cross-border ecommerce websites and apps will have a significant positive effect on consumer online trust.

H2: Perceived ease of use for cross-border ecommerce websites and apps will have a significant positive effect on consumer online trust.

H3: Perceived security for cross-border ecommerce websites and apps will have a significant positive effect on consumers' online trust.

H4: Trust propensity will have a significant positive effect on consumer online trust.

H5: Perceived usefulness of cross-border ecommerce websites and apps will have a significant positive effect on consumers' purchase intention.

H6: Perceived ease of use for cross-border ecommerce websites and apps will have a significant positive effect on consumers' purchase intention.

H7: Perceived security for cross-border ecommerce websites and apps will have a significant positive effect on consumers' purchase intention.

H8: Trust propensity will have a significant positive effect on consumers' purchase intention.

H9: the effect of perceived ease of use on consumers' purchase intention is mediated by online trust.

H10: the effect of perceived usefulness on consumers' purchase intention is mediated by online trust.

H11: the effect of perceived security on consumers' purchase intention is mediated by online trust.

H12: the effect of trust propensity on consumers' purchase intention is mediated by online trust.

From the first hypothesis to the fourth one, they are the influencing factor hypotheses of online trust. From the fifth hypothesis to the ninth one, the model was designed to verify the direct impact on purchase intention of four independent variables, which are perceived usefulness, perceived ease of use, perceived security and trust propensity. From the tenth hypothesis to the twelve one, they are the four antecedents variables hypotheses of purchase intention.

SCALE, QUESTIONNAIRE AND DESCRIPTION STATISTICS

According to the above, the variables in this study are as follows: perceived usefulness, perceived ease of use, perceived security, trust propensity, online trust, return policy and consumer's purchase intention. The above variables are mainly designed based on the scale in the existing research papers, and the specific content and references are shown in table 1 below:

Table 1 Scale design

Variables	Measurement	Reference
Perceived usefulness	<ol style="list-style-type: none"> 1. This website has enough overseas products for me to choose. 2. Compared with Haitao, purchasing, etc., shopping on this website is cheaper. 3. This website can provide perfect after-sales service, delivery is timely 4. This website shopping can keep me up to date with the fashion. 5. This website can provide detailed and sufficient shopping help information. 	Paul A. Pavlou (2003) Urvashi Tandon, Ravi Kiran, Ash Sah (2017)
Ease of use	<ol style="list-style-type: none"> 1. Shopping on this site can take less time 2. Worries about not buying fakes on this website 3. The trading process of this website is very simple 4. This website can easily search for the products I need. 5. The interface of this website is friendly and easy to operate. 	David Gefen, Detmar W. Straub (2000)
Perceived security	<ol style="list-style-type: none"> 1. The product quality of this website is reliable 2. The product information on this website is authentic and reliable. 3. The payment process of this website is safe and reliable. 4. The product package purchased on this website is in good condition. 5. This website will not reveal my personal information. 	Andrew Rohm, Vanitha Swaminathan. (2004)
Trust	<ol style="list-style-type: none"> 1. I easily trust a person or thing 	David Gefen, Detmar W. Straub

propensity	2. I have a high probability of trusting a person or thing 3. In most cases, people's interaction with him is honest.	(2000)
Online trust	1. This website will fully consider the interests of customers. 2. I believe that the information provided by the website 3. The website will fulfill its commitment to customers	D. Harrison McKnighta, Vivek Choudhuryb, Charles Kacmarc. (2002)
Purchase intention	1. If the website has the goods I need, I will buy it on the website. 2. I think it is more willing to buy on this website than other websites. 3. I will recommend other people to shop on this website.	William Boulding, Ajay Kalra, Richard Staelinet al. (1993) Ilias O. Pappas Panos E. Kourouthanassis Michail N. Giannakos George Lekakos (2017)

Firstly, we selected the scale mainly referring to the previous literature research. And they were appropriately modified according to the characteristics of cross-border e-commerce. Secondly, we modified the questions based on the scientific discussion and other scholars' suggestion. Thirdly, after the basic design of the questions was completed, an in-depth interview was conducted to investigate its fitness of cross-border e-commerce as well as the respondents' feelings of completing the questionnaire. Then we continued to make corresponding modifications. Finally, the questionnaire design specification was appropriately formed, and the final questionnaire is finished.

This study used the Likert five-point scale, which mainly considers that it is difficult for consumers to measure the accuracy of the 7-point scale when filling out the questionnaire. For the three-point scale, the measurement is not very accuracy. Therefore, it was decided that the study used a 5-point scale.

We distributed the questionnaire based on the stochastic rules. According to the goal of study, the sample group of this research is mainly based on the mainstream population covering cross-border online shopping consumers. Considering of relevant research papers, it is found that the cross-border online shopping group is mainly composed of young and middle-aged groups such as students and young white-collar workers. The most popular category of cross-border e-commerce is female related, so the female group is also the main target of our research.

Therefore, this study used the Questionnaire Star as a tool to fill in our questionnaire via mobile apps such as WeChat and Weibo. At the same time, female white-collar workers are the main consumer groups of cross-border online shopping, so we also issued paper questionnaires in commercial areas with large number of offline customers on weekends and holidays as complements.

DATA ANALYSIS AND RESULTS

Descriptive Statistical Analysis

The questionnaire was distributed in the form of a web-linked questionnaire, and 276 valid responses were collected. The questionnaires linked to the webpage are mainly shared by WeChat. Table 2 below is a descriptive statistics of the respondents.

Table 2 The result of descriptive statistical analysis

Descriptive indicator	Category	Frequency	Proportion
Sex	Male	88	31.9%
	Female	188	68.1%
Age	Under 18 years old	8	2.9%
	18-25 years old	193	69.93%
	25-35 years old	59	21.38%
	35-50 years old	15	5.43%
	Over 50 years old	1	0.36%
Education	High school and below	5	1.81%
	College degree	40	14.49%
	Bachelor degree	219	79.35%
	Master degree and above	12	4.35%
Occupation	Student	158	57.25%
	Enterprise employee	86	31.16%
	Government employee	18	6.52%
	Freelance	14	5.07%
	other	0	0%
Disposable income	1500 yuan and below	96	34.78%
	Between 1500 and 3000 yuan	69	25%
	Between 3000 and 5000	73	26.45%

Online shopping frequency	yuan		
	Between 5000 and 8000 yuan	25	9.06%
	Above 8000 yuan	13	4.71%
	sometimes	49	17.75%
	occasionally	122	44.2%
	often	105	38.04%

The result descriptive statistics of the table **Table 2** is as follows: Female consumers accounted for nearly 70%; 18-25 years old accounted for nearly 70%; undergraduate and graduate students accounted for nearly 85%; students and enterprises accounted for nearly 90%. The questionnaire was distributed in line with the current mainstream characteristics of online shopping.

Disposable income is concentrated between 1,500 and 5,000 yuan, which is in line with the income characteristics of respondents. The frequency of online shopping accounted for 38% of cross-border online shopping, and this result indicated the current trend and research feasibility of cross-border online shopping.

Through the above simple analysis, we can see that the respondents of questionnaire are basically in line with the research purpose. The labels of cross-border online consumers are young and female. It provided our research a good data foundation.

Reliability Test And Validity Test

This paper will use the Cronbach' Appha coefficient to verify the consistency of the scale. The reliability analysis test results are specifically shown in table 3 below:

Table 3 Reliability Analysis Results

Variables	Items	Cronbach's Aolpha if if item Deleted	Cronbach's Aolpha
Perceived usefulness	A1	0.776	
	A2	0.766	
	A3	0.762	
	A4	0.812	
	A5	0.828	
	Five		0.827
Ease of use	B1	0.762	
	B2	0.751	
	B3	0.749	
	B4	0.751	
	B5	0.757	
	Five		0.797
Perceived security	C1	0.851	
	C2	0.843	
	C3	0.882	
	C4	0.861	
	C5	0.872	
	Five		0.893
Trust propensity	D1	0.803	
	D2	0.762	
	D3	0.698	
	Three		0.819
Online trust	E1	0.803	
	E2	0.652	
	E3	0.792	
	Three		0.818
Purchase intention	G1	0.839	
	G2	0.769	
	G3	0.779	
	Three		0.860

As can be seen from the above table, the reliability values of each variable are greater than 0.7, and the Cronbach Bahrain alpha coefficient after each item is deleted is lower than the variable reliability value. The result indicated that the scale had a very good reliability, that is, various measurement items the questionnaire can be used to describe the variables in a stable and

realistic explained.

Validity analysis is composed of analysis of content validity and analysis construct validity. Content validity can also be referred to as surface or logical validity, primarily as a subjective and systematic assessment of the measurement tasks performed on the necessary measurement of scales. The measurement scales for different variables of this questionnaire are based on domestic and foreign research papers that have been verified several times.

The construct dimension is a major indicator of the validity test. This paper used factor analysis to verify the construct validity of the scale. Generally speaking, before performing validity test, the KMO and Bartlett spherical test must first be performed on the questionnaire. When the KMO value exceeds 0.89, it means that the factor analysis of these variables is better. When the value is between 0.75 and 0.89, then this means that the model is very suitable for factor analysis. When it is between 0.55-0.65, factor analysis can be performed. When it is between 0.45-0.59, this means poor effect. The data of questionnaire should be abandoned when it is less than 0.45. The KMO and Bartlett spherical test result of this paper is shown in Table 4. The overall KMO value is 0.929, and the Bartlett test is 0.000. It means that there is a significant correlation between the data. Combined with the above two indicators, it can be judged that the data sample is suitable for the factor analysis method.

Table 4 KMO and Bartlett Test

Kaiser-Meyer-Olkin measurement of sufficient Sample		.929
Bartlett's sphericity test	Approximate chi square	5776.663
	df	357
	Sig.	0.000

Table 5 shows the result of KMO measure of online trust variable and the Bartlett sphere test. The value of KMO is 0.669, and the P value is $0.000 < 0.001$, which means that this variable is suitable for factor analysis. The conclusion of factor analysis is that the factor loading of different items of online trust exceeds 0.79, and the variance explained by this factor is 73.04%. So it means that the construct validity test result of the variable is very good.

Table 5 Component Matrix, KMO and Bartlett test of online trust

Variable	Item	Factor loading	KMO	Bartlett test
Online trust	E1	0.829	0.669	0.000
	E2	0.897		
	E3	0.829		

The result of KMO test and the Bartlett sphere test of purchase intention is shown in Table 6, and the factor analysis also showed that the construct validity of this variable is good. Then the rest variables of the model passed the construct validity test, such as perceived usefulness, perceived ease of use, perceived security and trust propensity. We didn't show the test result of them due to the length of the paper.

Table 6 Component Matrix, KMO and Bartlett test of purchase intention

Variable	Item	Factor loading	KMO	Bartlett test
Purchase intention	G1	0.862	0.721	0.000
	G2	0.914		
	G3	0.902		

Empirical Analysis Of Factors Affecting Purchase Intention

Correlation analysis between variables

As can be seen from Table 7, the correlation coefficients between usefulness, ease of use, security, trust tendency and online trust are 0.701, 0.607, 0.692 and 0.802 respectively. The above coefficients are significantly correlated at the 0.001 level. Therefore, the preliminary judgement can be made that H1, H2, H3, and H4 are established.

Table 7 Correlation analysis between online trust and its determinants

		Perceived usefulness	Ease of use	Perceived security	Trust Propensity	Online trust
Perceived usefulness	Pearson correlaton	0.979	0.641***	0.639***	0.741***	0.701***
	Significance (two sides)		0.000	0.000	0.000	0.000
Ease of use	Pearson correlaton	0.641***	1	0.602***	0.619***	0.611***
	Significance (two sides)	0.000		0.000	0.000	0.000
Perceived security	Pearson correlaton	.638***	.613***	1	.723***	.683***
	Significance (two sides)	0.000	0.000		0.000	0.000
Trust Propensity	Pearson correlaton	0.752***	0.618***	0.713***	1	0.826***
	Significance (two sides)	0.000	0.000	0.000		0.000
Online trust	Pearson correlaton	0.701***	0.612***	0.683***	0.805***	1

	Significance (two sides)	0.000	0.000	0.000	0.000	
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Note: ***Represents a significant correlation at the 0.1% level (both sides).

It can be found that the correlation coefficients between usefulness, ease of use, safety, trust tendency and purchase intention are 0.661, 0.638, 0.651 and 0.751 respectively in the Table 8. The above coefficients are significantly correlated at the 0.001 level. So, the preliminary judgement can be made that H5, H6, H7, and H8 are established.

Table 8 Correlation analysis between purchase intention and its determinants

		Perceived usefulness	Ease of use	Perceived security	Trust Propensity	Purchase intention
Perceived usefulness	Pearson correlaton	1	0.641***	0.639***	0.741***	0.661***
	Significance (two sides)		0.000	0.000	0.000	0.000
Ease of use	Pearson correlaton	0.641***	1	0.602***	0.619***	0.639***
	Significance (two sides)	.000		0.000	0.000	0.000
Perceived security	Pearson correlaton	0.639***	0.602***	1	0.712***	0.651***
	Significance (two sides)	.000	.000		0.000	0.000
Trust Propensity	Pearson correlaton	0.752***	0.619***	0.723***	1	.746***
	Significance (two sides)	0.000	0.000	0.000		0.000
Purchase intention	Pearson correlaton	0.662***	0.648***	.652***	.756***	0.986
	Significance (two sides)	0.000	0.000	0.000	0.000	

Note: ***Represents a significant correlation at the 0.1% level (both sides).

It can be found that the correlation coefficients between online trust and purchase intention are 0.747, 0.747 respectively in the Table 9. The above coefficients are significantly correlated at the 0.001 level. So, the preliminary judgement can be made that H9 is established.

Table 9 Correlation analysis between purchase intention and online trust

		Online trust	Purchase intention
Online trust	Pearson correlaton	0.967	.747***
	Significance (two sides)		0.000
Purchase intention	Pearson correlaton	0.747***	0.988
	Significance (two sides)	0.000	

Note: ***Represents a significant correlation at the 0.1% level (both sides).

Regression analysis of influencing factors

According to the previous analysis results, some hypotheses of this paper have obtained preliminary verification, but the correlation analysis can only analyze the dependence and tightness between different variables. Moreover, it cannot explain the causal relationship. The paper used the method of multiple regression to study the causal relationship and mediating effects of the research hypothesis.

Firstly, the four influencing factors of online trust are taken as independent variables, and online trust is used as the dependent variable to carry out regression analysis to test the influence of usefulness, ease of use, security and trust propensity on online trust. The result of regression analysis in Table 10 showed that the value of the adjusted R-square is 0.679, the Sig value of Perceived usefulness is 0.019, the Sig value of ease if use is 0.011, the Sig value of perceived security and trust propensity are 0.000. All of variables' Sig value are less than 0.05, so the overall regression effect is significant.

Regression analysis further proved that online trust is affected by usefulness, ease of use, security, and trust propensity. In the table 10, the four independent variables have positive effects on online trust, and the weight of trust propensity to be the largest

one (0.499), indicating that the consumer's trust propensity is the strongest one. The remaining independent variables from large to small according to influence which are sorted as follows: perceived security (0.183), perceived usefulness (0.172) and ease of use (0.131). Therefore, it was showed that H1, H2, H3, and H4 were verified.

Table 10 Regression results of impact factors and online trust

Dependent variable	Independent variables	Non-standardized coefficients		Standardized coefficients	t	Sig.
		B	Stand error			
Online trust	Const	0.221	0.139	0.214	1.551	0.119
	Perceived usefulness	0.172	0.051	0.159	3.061	0.019
	Ease of use	0.131	0.051	0.131	2.901	0.011
	Perceived security	0.183	0.052	0.201	3.721	0.000
	Trust propensity	0.499	0.059	0.501	8.742	0.000

Secondly, the four influencing factors of purchase intention are taken as independent variables, and purchase intention is used as the dependent variable to carry out regression analysis to test the influence of usefulness, ease of use, security and trust propensity on purchase intention. The result of regression analysis in Table 11 showed that the value of the adjusted R-square is 0.631, the Sig values of Perceived usefulness and perceived security are 0.039, the Sig values of ease of use and trust propensity are 0.000. All of variables' Sig value are less than 0.05, so the overall regression effect is significant.

Regression analysis further proved that purchase intention is affected by usefulness, ease of use, security, and trust propensity. In the Table 11, the four independent variables have positive effects on online trust, and the weight of trust propensity to be the largest one (0.480), indicating that the consumer's trust propensity is the strongest one. The remaining independent variables from large to small according to influence which are sorted as follows: ease of use (0.237), perceived security (0.172) and perceived usefulness (0.109). Therefore, it was showed that H5, H6, H7, and H8 were verified.

Table 11 Regression results of impact factors and purchase intention

Dependent variable	Independent variables	Non-standardized coefficients		Standardized coefficients	t	Sig.
		B	Stand error			
Purchase intention	Const	0.059	0.171	0.048	0.370	0.708
	Perceived usefulness	0.109	0.061	0.100	1.741	0.039
	Ease of use	0.237	0.062	0.221	4.349	0.000
	Perceived security	0.172	0.063	0.1619	2.909	0.039
	Trust propensity	0.480	0.071	0.428	6.981	0.000

Finally, the regression model used online trust as an independent variable, and the consumer's willingness to purchase is a dependent variable in the Table 12. It is found that the value of R-square is 0.571, the Sig value of online trust and consumer's willingness to purchase is 0.000 less than 0.001. So the regression effect is significant. The regression coefficient of the online trust is 0.819, indicating that the significant influence on dependent variable is positive, and the hypothesis of H9 was verified.

Table 12 Regression results of online trust and purchase intention

Dependent variable	Independent variables	Non-standardized coefficients		Standardized coefficients	t	Sig.
		B	Stand error			
Purchase intention	Const	0.652	0.1628	0.568	4.178	.000
	Online trust	0.819	0.038	0.751	19.357	.000

The mediating effect of online trust

The mediation effect mainly explores the indirectly relationship between variables, that is, dependent variable can be influenced by independent variables through one or more intermediate variables. For the theoretical model of this research, we can easily find that consumers' online trust is a mediating variable between usefulness, ease of use, security, trust propensity and consumer's cross-border online shopping intention. For the inspection of mediating effect, the main analysis methods are as follows:

There are four influencing factors of online trust in the model, namely perceived usefulness, ease of use, perceived security and trust propensity. Online trust is a mediating variable, and consumers' purchasing intention is the dependent variable. Therefore, the variables are regression according to the above method. The analysis results are as follows in the Table 13.

Table 13 Mediating effect test of perceived usefulness

	Dependent variable	independent variable	Non-standardized coefficients		Standardized coefficients	t	Sig.
			B	Standard error			
Model 1	Purchase intention	Const	0.851	0.201	0.798	4.451	0.000
		Usefulness	0.721	0.052	0.660	14.671	0.000
Model 2	Purchase intention	Const	0.279	0.171	0.216	1.670	0.096
		Usefulness	0.282	0.059	0.247	4.811	0.000
		Online trust	0.631	0.063	0.581	11.020	0.000

From the regression results in the Table 13, it can be seen that after the second variable is added, the online trust is significant at the level of $p=0.001$, and the usefulness factor is still significant at the level of $p=0.001$. However, the standard regression coefficient decreases from 0.721 to 0.282, it shows that online trust has a partial mediate effect on the relationship between perceived usefulness and consumer purchase intention.

From the regression results in the Table 14, it can be seen that after the second variable is added, the online trust is significant at the level of $p=0.001$, and the ease of use factor is still significant at the level of $p=0.001$. However, the standard regression coefficient decreases from 0.691 to 0.272, it shows that online trust has a partial mediate effect on the relationship between ease of use and consumer purchase intention.

Table 14 Mediating effect test of ease of use

	Dependent variable	independent variable	Non-standardized coefficients		Standardized coefficients	t	Sig.
			B	Standard error			
Model 1	Purchase intention	Const	1.247	0.168	1.198	7.401	0.000
		Ease of use	0.718	0.047	0.638	14.151	0.000
Model 2	Purchase intention	Const	0.272	0.161	0.210	1.719	0.091
		Ease of use	0.318	0.047	0.302	6.448	0.000
		Online trust	0.632	0.047	0.583	12.591	0.000

From the regression results in the Table 15, it can be seen that after the second variable is added, the online trust is significant at the level of $p=0.001$, and the trust propensity factor is still significant at the level of $p=0.001$. However, the standard regression coefficient decreases from 0.829 to 0.449, it shows that online trust has a partial mediate effect on the relationship between trust propensity and consumer purchase intention.

Table 15 Mediating effect test of trust propensity

	Dependent variable	independent variable	Non-standardized coefficients		Standardized coefficients	t	Sig.
			B	Standard error			
Model 1	Purchase intention	Const	0.533	0.158	0.508	3.208	0.001
		trust propensity	0.829	0.0439	0.751	19.062	0.000
Model 2	Purchase intention	Const	0.252	0.1619	0.204	1.593	0.108
		Ease of use	0.449	0.072	0.448	6.790	0.000
		Online trust	0.472	0.070	0.428	7.118	0.000

In summary, online trust has partial mediating effects between the four independent variables (perceived usefulness, ease of use, perceived security, trust propensity) and dependent variables (purchasing intention). Therefore, it was showed that H9, H10, H11, and H12 were verified.

Based on the above empirical analysis, the following conclusions are drawn: the perceived usefulness, ease of use, perceived security and consumer trust propensity of the cross-border e-commerce websites and apps will significantly affect online trust, and will also positively affect consumers' willingness to cross-border online shopping. Consumers' online trust will also

significantly affect their willingness to purchase, and have a partial mediating effect between the above four independent variables and purchase intention.

CONCLUSIONS AND IMPLICATIONS

Conclusions

The main purpose of this paper is to explore the influencing factors of consumers' willingness to purchase in the cross-border e-commerce websites and apps. We believe that the most significant factor affecting consumers' cross-border online shopping is distrust. Therefore, this study divided online trust of cross-border online shopping into four dimensions, and extracted four independent variables which are perceived useful, easy to use, perceived security and consumer trust propensity according to the TAM theory. Moreover, we used consumers' online trust as a mediator variable, constructed an expanded TAM research model to explore the mechanism and determinants of consumers' cross-border online shopping.

Firstly, the above empirical results show that the usefulness of the cross-border online websites and apps will significantly affect consumers' online trust and their willingness to purchase, and both of which are significant at the 0.001 level. At the same time, online trust has a partial mediating effect on the relationship between the perceived usefulness and purchase intention. The validity of this conclusion has also been proved by some other scholars.

Nowadays, cross-border online shopping is very hot, and a lot of related cross-border e-commerce platforms and small and medium-sized cross-border e-commerce companies are emerging one after another. After all, the development of cross-border online shopping eco-system is too fast to be a mature one. Some cross-border e-commerce platforms and companies lack of experience and prospects. Therefore, some customers are not satisfied with some cross-border e-commerce platforms and companies. Some customers maybe give up the shopping on the cross-border e-commerce websites and apps for the sake of lacking trust.

But for young or high-income groups, cross-border online shopping is easily to be accepted because of buying global and high-quality goods. In addition, the group who are pursuing new things feel that cross-border online shopping is a very fashionable shopping method. This group of the population will also perceive the value of cross-border online shopping. According to the above analysis, we found that different people have different perceptions of the value of cross-border e-commerce, which indirectly affects the online shopping intentions of different consumers.

Secondly, the ease of use of the websites and apps is crucial to the purchase willingness of cross-border e-commerce users. Through the above data analysis, it can also be found that the ease of use of the websites and ease has a positive impact on consumers' online trust and online purchase intention, and both of which are significant at the 0.001 level. Then online trust has a partial mediating effect on the relationship between ease of use and purchase intention.

For cross-border e-commerce websites and apps, the transaction process is more complicated than traditional domestic online shopping. Consumers need to provide more detailed information, such as payment information and logistics clearance information. Due to the international logistics and customs clearance, consumers need to verify the accuracy of the information, which puts a great challenge on the ease of use of the websites and apps. Then variable international tax rules also make the cross-border online shopping process more complicated than that of traditional one. So how to make the transaction process of the cross-border online shipping less complicated is very important.

Thirdly, the perceived security is very important impact factor to the purchase willingness of cross-border e-commerce customers. We also found that the perceived security has a positive impact on consumers' online trust and online purchase intention, and both of which are significant at the 0.001 level. Then perceived security has a partial mediating effect on the relationship between ease of use and purchase intention.

Compared with domestic online shopping, cross-border online shopping has many risks as follows: the risk of authenticity and quality of goods sold on cross-border e-commerce platforms, the risk of logistics security issues (Customs maybe seize the goods in case of not fully clearance information, and etc.), the risk of payment security and qualification verifying of cross-border e-commerce. Therefore, security considerations are an important factor affecting consumers' cross-border online trust.

Fourthly, the trust propensity of customers of the websites and apps is crucial to the purchase willingness of cross-border online shop. Moreover, this factor is a relatively stable internal personality trait that is difficult to change with the external environment. We find that consumers' trust propensity can affect consumers' online trust and their willingness to buy, even if it tends to be difficult to change. In daily life, we can explain it easily: Consumers of risk-averse personality traits will basically have reservations about emerging things, and will not change their mind to the extent even if cross-border e-commerce platforms and companies make a lot of efforts.

Implications

According to the research conclusions obtained in the paper, based on the characteristics of domestic cross-border e-commerce platforms and companies, the implications are as follows.

Firstly, we found that it can improve the perceived usefulness of customers by expanding the range of products offered by cross-border e-commerce platforms and companies. The mainstream cross-border e-commerce platforms in China basically only provides hot-selling products such as maternal and child, cosmetics and clothing as well. The single-selling products mainly based on “explosive product” are often sold in hot-selling categories, so that consumers are difficult to feel the value of cross-border e-commerce for a wider range of other products.

Secondly, we found that it can improve the ease of use by simplifying the cross-border shopping process on the related websites and apps. Because cross-border online shopping will inevitably increase the complexity of shopping process due to the difficulties of product listing, the comprehensiveness of customs clearance, and the restrictions on payment terms. Therefore, it is necessary to simplify the cross-border online shopping process.

Thirdly, it can improve the perceived security by increasing qualification displaying of the cross-border online shopping websites and apps. Consumers’ perceived security will have an impact on their cross-border online shopping intentions. So cross-border online platforms and companies can cooperate with the famous brand and official brand to reduce the perceived risk of cross-border e-commerce consumers.

Finally, it is crucial to form the cross-border e-commerce brand which is focused on word-of-mouth promotion. Purchase intention is significantly affected by consumers’ online, and online trust is also influenced by branding and word of mouth. As the cross-border e-commerce platform or company, it should increase its brand recognition level through different communication channels. On the other hand, for the reviews function inside the websites or apps, they should strengthen the customer service capabilities, responding promptly to problems generated by consumers, and giving consumers a positive brand impression through online reviews etc.

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The More You Know, the More You Buy? Knowledge and Engagement Drive Luxury Purchasing

(Full Paper)

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ABSTRACT

The market for luxury goods has changed drastically for the most recent two generations of consumers, who account for almost half of these types of purchases. This is due in part to their integration of using the internet for online shopping, as well as their relationship to luxury goods. We tested eight hypotheses about the luxury goods purchasing behavior of these two generations. Each of the hypotheses has proven statistically significant, which suggests that marketing strategies for luxury goods need to change to address the different wants, and needs of a changing market. These research results suggest that consumer knowledge and awareness have a positive correlation with their level of trust, and risk in luxury brands. The implications of this suggest that practitioners of luxury goods marketing should invest in marketing strategies that address certain social peer groups, which can significantly influence their target market.

Keywords: luxury goods marketing, luxury retail strategy, consumer brand knowledge perspective, luxury in the digital era

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NEW MARKETS FOR LUXURY GOODS

With the rapid global expansion of luxury brands over the past two decades, luxury consumer behavior, and their values have changed at an equal pace through a multichannel brand knowledge learning process. While the global luxury market is ultra-competitive; it has increasingly flourished over the past few decades and will reach €280 billion in size by 2020 on account of its 3–4% mild-pace growth (Bain and Company, 2017). However, according to Deloitte (2017), an increasing number of luxury brands are struggling due to sudden changes in competitive marketplaces. For example, some are afraid to embrace e-commerce, while others are unaware of how they could manage a digital brand transformation, or the impact that their marketing strategy has on vastly different cultures around the world.

Although luxury consumption behavior has received attention from both the business world, and academia in recent years, there is still very little research about luxury consumer behavior analysis based on knowledge–attitude–behavior perspectives. To understand the relationship between a consumer’s knowledge of luxury brands, and how that influences their attitude and behavior, we proposed a framework based on the Theory of Planned Behavior (Ajzen, 1991), and a consumer luxury brand knowledge perspective to illuminate consumer word-of-mouth and purchase behaviors.

Firstly, Ajzen's theory as a research starting point suggests that consumer attitudes, and subjective norms trigger their purchase intentions, and perceived behavior control. It further explores consumer behavior, which results in the formulation, and design of the proposed research model.

Secondly, we examined consumer knowledge by integrating brand familiarity, luxury involvement, and brand country-of-origin (COO) identification with luxury shopping experiences to test the proposed framework.

China plays a vital role in global luxury consumption, contributing 770 billion RMB (\$115 billion USD) in 2018 on luxury items—equivalent to a third of the entire global spend (McKinsey and Co. 2018). I chose Chinese consumers (mainly millennials, and generation z) as my research sample, and provided business insights for practitioners to do future research. Amongst the luxury consumer groups, it is important to define younger generations, especially the two most prominent purchasers of luxury goods: millennials (those born between the early 1980s and the mid-1990s) and generation Z (those born after the mid-1990s). It’s estimated that these two groups will account for 45% of luxury-market consumption by 2025 (Bain and Company, 2017).

Younger Consumers in the digital age mainly receive brand information from digital technology, including social media. They have specifically expanded their brand knowledge via online, and offline resources, and may internalize it (Keller, 2003). Millennials grew up with the Internet, and gen z cannot imagine a world without it. (Forbes, Apr 18th 2017). They have contrasting values from their parents’ generation, and no longer buy luxury brands as status symbols. This behavior has disrupted the established luxury paradigm (Bain and Company, 2018).

Previous generations such as baby-boomers, and generation X experienced something close to what was defined by Goody as “Refined enjoyment, of elegance, of things desirable but not essential” (Goody, 2004). This describes luxury as representing the

recognition of financial success and wealth. Typically, this kind of luxury plays a vital role in shaping self-presentation in public and business environments. On the other hand, millennials and generation z purchase luxury brand “to feel different rather than fit in with society” (McKinsey, 2018). However, with the changing luxury paradigm, a question arises regarding what motivates modern consumers to buy luxury brands.

Academically, some attention has been paid to the consumer perceptions of luxury brands (Christodoulides et al., 2009; Vigneron and Johnson, 1999; Vickers and Renand, 2003). Others have discussed the COO’s effects on consumer decisions when purchasing luxury goods (e.g., Lampert and Jaffe, 1998; Ahmed et al., 2004; Koschate-Fischer et al., 2012). However, until now there has been little research on the effect of luxury brand knowledge on the behavior of digitally integrated consumers.

Owing to advanced digital devices, and platforms, consumption in the luxury business industry has allowed customers to shop wherever they physically visit, or e-visit. For example, McKinsey (2018) reported that by 2018, global digital sales for women’s luxury fashion were expected to grow from their current 3% of the total market to 17%, making a total market size of \$12 billion USD. Meanwhile, consumers are gaining brand knowledge from multichannel social media, and their purchasing experiences. Furthermore, recent innovative technologies have enabled consumers to receive extensive information about luxury brands such as through 3D tours on websites, and stories on Instagram, or Facebook

DISSEMINATING CONSUMER BRAND KNOWLEDGE

‘Consumer brand knowledge’ relates to the cognitive representation of a brand (Peter and Olson, 1999). It is defined in terms of how a consumer has adapted personal meaning from a brand, and committed it to their memory. For example: all descriptive, and evaluative brand-related information. Based on this concept of consumer memory, there are two key aspects to utilizing it in the branding-leveraging process.

First, the level of existing consumer brand knowledge will affect how in-depth their knowledge is in regards to a brand.

Second, leveraging entails linking the brand to other entities in consumers’ lives, such as knowing how brand knowledge functions as a trigger, and antecedent of consumption is an effective way to decipher consumer behavior (Keller, 2003; Kuo and Nagasawa, 2018).

According to Keller (2003) brand knowledge is composed of multiple factors (awareness, attributes, benefits, image, thoughts, feelings, attitudes, and experiences), which include personal cognitive, and affective responses to any brand-related information, formatted into overall brand evaluation, becoming a part of consumer memory, and leading to consumption behavior. These factors guide the research hypotheses in this article: more informed luxury brand knowledge positively affects consumer trust, which in turn influences a perceived lower risk for certain brands, and will positively affect purchase intention, as well as actual purchase.

Brand Familiarity

Brand familiarity signifies the extent—both direct and indirect—of a consumer’s experience with a brand (Alba and Hutchinson, 1987; Kent and Allen, 1994). Examples of this include consumer in-store purchasing experiences, searches for brand products, and visits to online platforms that display information about brand items, features, or history.

Luxury brands may invest in marketing strategies that collaborate with online platforms to showcase their brand story, or heritage. Similarly, luxury brands hold international fairs, cross-promote with popular entertainers, and leverage relationships with technology companies to increase both conscious, and unconscious brand familiarity among potential customers, and to capture the consumer knowledge structure about a brand (Campbell and Keller, 2003).

Luxury Involvement

Luxury involvement represents the degree to which a consumer regards a specific purchase decision, and perceives it as important to them (Schiffman and Kanuk, 1983). This is particularly relevant for consumers who are willing to invest time, and money into purchasing decisions more often than ordinary customers, or who regularly check contemporary seasonal products. These individuals usually belong to a peer group or social network that shares an approach to, and perception of luxury involvement. Such consumers can join e-forums, or brand communities, to share, and discuss brand personalities, design, and other pertinent topics.

Consumers with higher luxury involvement tend to be early adopters of fashion trends, and demonstrate higher fashion awareness. Such consumers are much more willing to try trendy, or novel products (Zhang and Kim, 2013).

Brand Country of Origin Identifiability

Brand Country Of Origin identifiability is defined as the place, region, or country from which a brand is perceived to belong to by its target consumers (Thakor and Kohli, 1996). This also refers to the strength of the brand node in the memory, the country of origin. For example, the luxury brand Hermes is famous for its craftsmanship, and extraordinary leather goods. Customers expect Hermes bags to be handmade in France, rather than made in some other country. Some prior studies have argued that COO significantly effects the evaluations of product quality and perception, and it positively affects consumers’ willingness to pay

higher prices for luxury brands (Dinnie, 2004). For example, Chinese businessmen build factories in rural Italy in order to label their product 'MADE IN ITALY'. These "Italian" products are sold at a premium price in Chinese locales like Taobao or TMall very well. Thus, brand COO identifiability is a key factor that contributes to consumer brand knowledge.

Brand Trust

According to some research, developing a long-term loyalty program with customers requires that business practitioners first gain their trust (Reichheld and Scheffer, 2000). When consumers are aware of, and can comprehend the knowledge structure of a luxury brand, and hold positive associations with the brand in their minds, it leads consumers to place more trust in the brand, and perceive less risk from that brand. Behavioral evidence shows that an increasing level of consumer trust in luxury brands leads to consistent consumer brand loyalty (Gassenheimer et al., 1998; Kuo and Nagasawa, 2015). For example, when someone praises a specific brand, that person is communicating a desire to be connected to the people who consume that brand (Husic and Cicic, 2009).

Mayer et al. (1995) argued that brand loyalty enables consumers to be more confident in predicting the future performance of a luxury brand, which is important because consumers are willing to pay more for brands, and will support companies' innovative, and new products over time. Highly recognizable brands can generate positive attitudinal responses with an increased number of repetitions. Therefore, it can be determined that such attitudinal responses to luxury-brand familiarity can lead to certain behavioral outcomes.

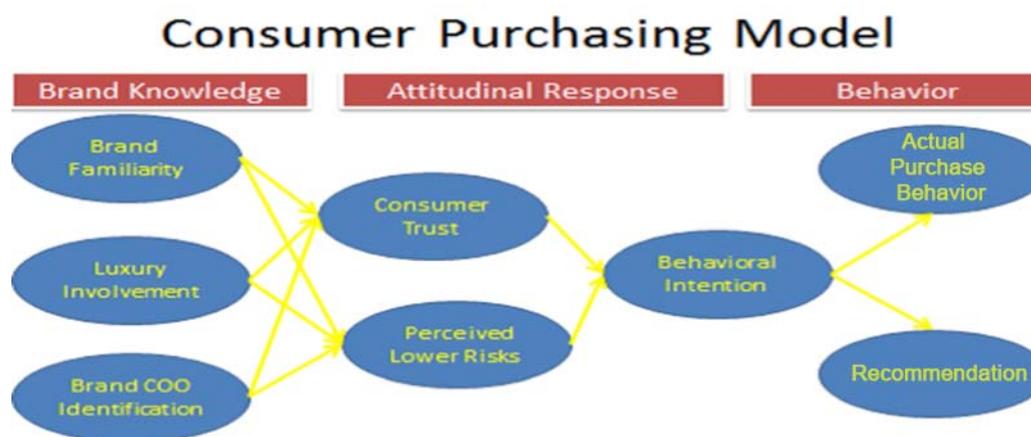


Fig 1

The Theory of Planned Behavior

Based on the theory of planned behavior (Ajzen, 1991), we proposed a knowledge–attitude–behavior research model as shown in Figure 1. This was designed to provide a comprehensive explanation of social behavior. According to TPB, behavior can be predicted by intention, which is dependent on attitude, subjective norms, and perceived behavior control. In addition to Ajzen's theoretical grounding, the two-factor theory (Berlyne, 1970) is a particularly pertinent model in the examination of current consumers' luxury brand knowledge.

The theory designates both novelty, and complexity as drivers of hedonic value. Novelty plays an essential part in motivation theory when it comes to luxury purchasing behaviors in areas of research such as exploratory behavior. Evaluating the novelty of a product is an impetus in individual experiences toward absorbing luxury brand knowledge through a range of exploratory behaviors such as surfing the Internet, mass media materials, or any physical shopping experience. These values represent attitudinal responses in our proposed model.

Attitude is a feeling of favored, or unfavored behavior with respect to a product (Ajzen, 1991). For example, if someone believes that gaining brand knowledge reduces their risk of being misinformed about the quality, reputation, or effectiveness of a brand, then they are more likely to search out such information about the luxury product. Consequently, they are more likely to regard such activity as worthwhile, which often leads to positive purchase decisions.

The psychological processes of customers have long been understood to play a role in the understanding of brand knowledge. Such processes play a part in driving attitudinal responses, and lead people to opt into luxury purchasing experiences, as well as to recommend luxury brands to others.

Subjective norms are the attitudes, or behaviors that exist around an individual that are considered typical. These may stem from cultural norms, group beliefs, or an individual's family, and social network. Beliefs concerning others' perceptions of the ownership of luxury brand products are key influences on purchasing decisions.

Finally, perceived behavior control can be described as a belief about the level of control someone has over their own environment. This means that a consumer is more likely to make positive buying decisions if they perceive that they can easily handle, or use a product. In summary, these three factors are reliable predictors of behavioral intention.

HOW BRANDING EFFECTS YOUR MARKET

'Brand familiarity' is defined as a store of favorable knowledge about a particular luxury brand that is accumulated by consumers' previous direct, or indirect purchasing experiences (Campbell and Keller, 2003). Searching for specific luxury brand products, and knowing more about brands can lead to higher familiarity with a brand, and might produce feelings of greater satisfaction, or trust, and a lower perceived risk. Thus, brand familiarity positively influences consumer trust (Ha and Perk, 2005). Lane and Jacobson (1995) also found that brand familiarity influences a brand value in the stock market, while stock market performance indirectly reflects consumer trust, and lowers perceived risk.

Brand Familiarity Has A Positive Effect

H1a: Brand familiarity has a positive effect on consumer trust.

H1b: Brand familiarity has a positive effect on perceived lower risk.

In terms of brand familiarity, the hypothesis is that familiarity with a brand will typically generate trust. Trust can be defined as one's willingness to be exposed to another based on the confidence that the other is benevolent, honest, open, credible, and well-qualified Karakuş and Savaş (2012) showed that willingness to be engaged in something has a positive relationship with trust.

Consumer engagement, involvement in the experience, connection to luxury brands, and information received about them from multiple channels such as physical stores, and online resources, lead to positive trust, and lower perceived risk. This study expands the concept of consumers' involvement in its examination of luxury brand involvement to validate the hypothesis between trust and brand involvement.

Brand Involvement Has A Positive Effect

H2a: Brand involvement has a positive effect on consumer trust.

H2b: Brand involvement has a positive effect on perceived lower risk.

Only limited research has been conducted into the effect of COO on services or products (Ahmed et al., 2002). However, it has been found that alongside a brand's corporate reputation, COO can significantly influence trust (Zaheer, 2006). One way of seeing trust is through categorization theory. According to Rosch (1978), individuals make use of various categories to describe the characteristics of objects to reduce the cognitive effort. Objects that combine most of a category's characteristics are defined as prototypes.

When confronted with a new stimulus, individuals categorize it by comparing it to their prototype. Prior knowledge associated with a prototype will be applied to the new stimulus. Following this rationale, countries can be viewed as categories. Based on the positive or negative experiences associated with a prototype within such a category, consumers will either reduce, or increase their initial trust toward a new stimulus. Therefore, those prototypical associations will vary between countries (Balabanis et al., 2002). For example, Germany is famous for automobile industry (BMW, Porsche) as COO, and consumers trust the mechanics of the cars themselves, as well as the long history of prestigious German automobile brands.

Brand COO Identification Has A Positive Effect

H3a: Brand COO identification has a positive effect on consumer trust.

H3b: Brand COO identification has a positive effect on perceived lower risk.

We collected data from a sample of 300 hundred Luxury consumers (Luxury shopping website members who had luxury purchasing experience in the past six months with specific handbag brands (such as Hermès or Chanel), are invited to attend a web-based survey. The questionnaire was adapted from prior studies, and based on the proposed research model, was used to collect confirmatory evidence from consumers with the conspicuous purchasing experience. To comprehend consumer behavior intentions toward luxury consumption, and actual buying behavior, this research collected empirical evidence to examine the research model's postulated hypotheses.

Measuring Trust

Measurement items of brand familiarity, luxury involvement, and brand COO identification were adopted from Campbell and Keller (2003), Zhang and Kim (2013) and Ahmed et al. (2002, 2004). Furthermore, the measurement items of trust, lower perceived risk, and behavioral intention were adjusted from Erdem et al. (2006) and Bian and Forsythe (2012).

For validity, one PhD student, and three experts checked the wording, and meaning of each item in a corresponding construct. All items were listed in the questionnaire, and each was measured by a seven-point Likert-type scale that ranged from 1 (strongly disagree) to 7 (strongly agree). The respondents were mainly young women under the age of 35, with luxury purchasing experience, and a high level of luxury brand knowledge.

The results satisfy the acceptance level that was suggested by the following related studies: the factor loadings of each measurement item surpass 0.7 as suggested by Hulland (1999), and the composite reliability exceeds 0.7 as suggested by Bagozzi and Yi (1988), and the discriminant validity criteria proposed by Fornell and Larcker (1981). Thus, Partial Least Squares Structural Equation Modeling (PLS-SEM) was conducted to assess the proposed model, and test the hypotheses proposed in this study.

Analysis Results

For measurement reliability and validity, this study conducts confirmatory factor analysis (CFA) to ascertain the reliability, and validity of the measurements used. First, the factor loadings of each measurement item are in the range 0.754–0.947, which surpasses the suggested level of 0.7 (Hulland, 1999). In conformance with prior studies, Cronbach's alpha is applied to assess the internal consistency reliability in social science research. Bagozzi and Yi, (1988) suggested using composite reliability (CR) as a placement. Composite reliability is represented by the overall reliability in a heterogeneous data collection and—as noted by Bagozzi and Yi (1988)—exceeds 0.7.

Based on the analysis results, the values of CR in the research model are in the range 0.842–0.952, which exceeds the acceptable level. In addition, this study assesses the convergent validity by evaluating the values of the Average Variance Extracted (AVE). All values of AVE in this study are in the range 0.641–0.831, which surpass the standard level value of 0.5 suggested by Fornell and Larcker (1981).

To calculate the discriminant validity, this study applies the approach suggested by Fornell and Larcker (1981) where the values of AVE are larger than the shared variance with other latent constructs. As shown in Table 1, the square root of the AVE is a diagonal entry with a correlation coefficient beneath.

Based on the measurement reliability, and validity test, this study employed Partial Least Squares Structural Equation Modeling. The findings show that brand familiarity, luxury involvement, and COO identifiability positively affect consumer trust in luxury brands. Luxury involvement has the strongest impact on consumer trust ($\beta = 4.752$, $p < 0.001$), followed by brand COO identifiability ($\beta = 3.905$, $p < 0.001$) and lastly, brand familiarity ($\beta = 2.108$, $p < 0.01$).

However, when it comes to lower perceived risk, only luxury involvement positively impacts consumers' lower perceived risk ($\beta = 4.231$, $p < 0.001$). Likewise, both consumer trust in luxury brands, and lower perceived risk positively influenced the intention to buy, and the intention to spread the brand image through word-of-mouth. Finally, the intention to buy positively influenced actual purchase behavior ($\beta = 3.501$, $p < 0.001$).



Fig 2

Turning Data Into Customers

Historically, published papers, and articles in this field have typically focused on the issue of consumer perceptions, and the COO of luxury brands. In this article we employed a consumer knowledge perspective to explain consumer purchasing, and word-of-mouth behavior in luxury markets based on the theory of planned behavior. Consumer trust, and risk perception are used as mediators between consumer knowledge, and behavioral intentions, empirically testing the construction of actual usage. Since consumer knowledge positively influences trust, and risks, practitioners can enhance the depth of their brand culture through marketing strategies. For example, various knowledge-based information could be broadcast through marketing activities. Such differential processing, and the presentation of brand story to a digitally integrated cohort could convey fresh brand knowledge to consumers with a high level of luxury involvement.

Another example is differentiation, and specialization. Marketing the differentiation in production methods can give consumers the opportunity to attain products with unique attributes through their brand knowledge. Some luxury brands emphasize that their products are made solely by hand, and of natural materials. The differentiation in their manufacturing process allows them to charge a substantially higher price than other brands. By engaging in such consumer brand knowledge activities, luxury brands can also develop connections with existing customers both intrinsically, and extrinsically, while also attracting new customers.

Specific Markets

The research questionnaire context of our research was luxury handbags; there may be limitations in the viability of extrapolating the findings that are made here to other sectors of the luxury field, and future research may be needed to collect data on other product categories.

CONCLUSIONS AND RECOMMENDATIONS

Our research shows that brand familiarity, luxury involvement, and brand COO identification all play an integral part in establishing consumer trust, which leads to consumer purchase intention, and actual purchase behavior. A higher degree of consumer trust will accelerate consumer intention to purchase brand products, and stronger intention to practice word-of-mouth behavior.

To increase awareness, and engagement with brand familiarity, luxury involvement, and brand COO identification in your luxury good marketing strategy, it will be essential to identify how your market is evolving, and has different needs from previous generations. This is especially true for the younger generations of the Chinese market, which is the growth engine for the luxury market, where they prefer experiential marketing.

Marketing strategies should focus on customers who may have a different set of needs, and reasoning for investing in luxury goods from the previous generation of consumers. Additionally, both physical, and online branding representation should be streamlined for authenticity using a multichannel approach, focusing on building brand trust, increasing brand awareness, and engaging customers in the brand story.

Increased customer engagement will lead to a higher volume of sales, as well as greater customer retention. Moving forward, a heightened awareness of the geographical market for luxury goods consumers, as well as where, and how they are bought, and sold, will continue to play a pivotal role in how, and where to implement marketing strategies.

This advice will be applicable for brands seeking to expand their marketing strategies toward the increasingly young consumers of luxury goods, as well as large foreign markets, like China.

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Tourist Wildlife Consumption Qualitative Considerations: Sabah, Malaysia

(Full Paper)

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ABSTRACT

This study of 464 outbound tourists at the Kota Kinabalu International Airport (KKIA) investigates their perceptions after visiting various protected wildlife destinations in Sabah, Malaysia. It considers the conservation of these tourism destinations. Tourists recognize the destination, its wildlife and the habitat as unique, special, and unpredictable. Respondent tourists offer shared knowledge and new understanding, and other considerations around Sabah's global wildlife tourist market – such as how to accommodation, travel, and cost can enhance (or degrade) Sabah's wildlife tourism activities and experiences, and how the service qualities around this wildlife tourism can be measures against the tourist's perceived satisfaction levels. The study concludes Sabah's wildlife and natural habitats do deliver substantive tourist experiences and activities, and these coalesce into strong overall satisfaction levels within the tourist.

Keywords: Sustainable tourism, destination experience, satisfaction, conservation, tourism wildlife behavior, qualitative.

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INTRODUCTION

Tourism and its associated travel is one of the world's largest industries. In 2016, its global economic contribution (direct, indirect and induced) exceeded US\$7.6T, whilst its direct economic impact (including accommodation, transportation, entertainment and tourism attractions) reached US\$2.3T (Anon, 2016).

Types Of Tourism

Vuoristo (2002) notes that the common conception is that travelling is done for three main purposes: (1) leisure, recreation and holidays, (2) business and professional and (3) visiting friend and relatives etc.). Regional tourism can either domestic tourism or international tourism. This can be further divided into groups including: culture tourism, mass tourism, nature-based tourism, and alternative tourism. Numerous niche tourism markets also exist. Tourism also considers impacts including: economic, ecological, and social impacts

Leiper (2008) suggests pull factors (such as: climate, geographical qualities, cultures others) are responsible for tourists travelling to a particular regions and then seeking a specific destination. Push factors entice an individual to travel (Järviluoma 1994). According to Leiper (1979) attractions include events, facilities, and sights. These orientate towards tourist experiential opportunities (Vuoristo, 1998). Further, the tourist often seeks attractions that are different from each. For example they may encounter different types of animals such as birds, fish, mammals, reptiles, and ideally not those in captivity (Tribe 2004).

Wildlife Tourism

Today, some tourists seek authentic natural pursuits including ecotourism, adventure, destination action/activities, wildlife encounters, and sustainable habitat/conservation engagements – whilst also seeking value-for-money (Saarinen, 2012). In such environments animal-based tourism can also be of a wildlife tourism and experiential format (Newsome et al., 2004; Saarinen, 2012). Here, there remains a strong relationship between tourist experiences and the type of tourism that typically utilizes the wildlife animal as a main attraction.

As one of the 12 mega diverse areas of the world, the Sabah Government through its Development Corporation, in 2007 claimed Sabah to be a global destination for experiencing international biodiversity attractions. To date, very few studies have investigated wildlife tourist satisfaction rather at a destination, or aligned to particular activities (Duffus and Dearden, 1993; Davis et al. 1997; Leuschner et al. 1989); Foxlee, 1999; Hammitt et al. 1993; Schanzel & McIntosh, 2000), and none have also collectively studied wildlife tourism in-situ (at destination).

Moscardo et al. (2001) qualitatively describes holiday wildlife tourism experiences. They observe the quality of experience is enhanced when a tourist touches or feels such animals – especially baby animals. Negatives are generated when tourists are harassed, frightened or attacked by wildlife, or when tourists note inadequate enclosures, facilities, explanations or welfare.

Swarbrooke et al. (2003) says 24-40% of tourists believe they are wildlife-related tourists, whilst 40-60% claim to be nature-related tourists. The Sabah Tourism Board 2011 states around half of Malaysia's population show interest in nature-based tourism. This study investigates the experiences of wildlife seeking tourists in Sabah Malaysia.

Study's Research Question

This study seeks to answer 'does Sabah's wildlife and natural habitats deliver the desired elements (experiences and activities) that invoke enhanced overall satisfaction targets for the tourist?' It also seeks to scrutinize tourist wildlife destination problems and possibilities in Sabah, and to use its acquired tourist information to assess what may be done on a wider scale around all aspects of its animal-based tourist encounters.

Wildlife-based tourism has a close relationship with nature tourism. Saarinen (2012) and Newsome et al. (2004; 2013) state nature tourism is a trending area - based on the natural environment and its attractiveness. This level of conservation and authenticity is also present in ecotourism.

Honey (2008) notes ecotourism is 'travel to relatively undisturbed or uncontaminated natural areas with the specific object of studying, admiring, and enjoying the scenery of its wild plants and animals, as well as any existing cultural aspects found in these areas.' Ecotourism is purposeful - including promotion/conservation, enjoyment/appreciation of nature and culture, and local economic/social benefits but generating minimal impact on the environment. It also has learning and adventure aspects (Fennell & Butler, 2003). Thus ecotourism relates to wildlife tourism aspects.

Yet another aspect of wildlife tourism is adventure tourism. Swarbrooke et al. (2003), terms this 'a physical phenomenon, involving tourists undertaking physical activities in unfamiliar and often inhospitable environments.' Adventure tourism also has non-physical attributes - including intellectual, emotional and spiritual aspects, along with danger, excitement, risk, novelty, and escapism (Swarbrooke et al., 2003).

In 2010 the Sabah Tourism Board stated Sabah's nature-based tourism as being utilized for: wildlife tourism for photography, jungle trekking, and observing/experiencing wildlife including: large animals, primates, and birds. Hence this study engages a wildlife tourism perspective. Higginbottom (2004) defines wildlife tourism as the type of tourism that is based on encounter with non-domesticated (non-human) animals. This also segments into 'wildlife-dependent' and 'wildlife-independent' forms of tourism (Higginbottom, 2004). This study approaches wildlife tourism as nature-based, and as in-habitat adventure related.

Aspects Of Wildlife Tourism

To some, wildlife watching is a non-consumptive form of tourism and therefore a true option of tourism. In watching wildlife, many different species in many different locations are involved in a non-destructive way - leaving the habitat and natural environment with a minimal tourist footprint. This requires supervision costs, and Valentine and Birtles (2004) note that tourist fees can sustain these protected areas – such as national parks.

Moscardo and Saltzer (2004) note tourists want to see animals in their natural settings. Yet, Bulbeck (2005) indicates exhibitions providing interactions (touching and feeding) with animals are of most interest. Lovelock, (2007) discusses hunting and fishing as additional tourist wildlife considerations. Bulbeck (2005) notes entertainment, especially in zoos, is another tourist drawcard - provided the welfare of the in-situ animal is first considered.

Swarbrooke et al. (2003) note geographical dimensions of adventure tourism are reducing, and this has created a tourist demand on the 'last wilderness destinations on earth. Timeliness is another tourist wildlife viewing factor, and although rainforests have substantive wildlife, this environment remains one with dense habitat and low visibility constraints (Valentine & Birtles, 2004). This study focuses on wildlife tourism in Sabah, Malaysia. Sabah state offers a significant range of tropical, coastal, mountainous, and rainforest habitats. These habitats also contain significant, globally-scarce, endemic wildlife species.

THEORETICAL FRAMEWORK

Data collected against the above wildlife tourism aspects is set against the following theories. Experience Theory and Animal Encounter Theory perceive animal encounters against wildlife experiences, and seek sustainability/conservation response ideas from tourists. Experience Theory captures tourist perceptions around their experiences of chosen wildlife attractions/activities. Biodiversity Hotspots Theory draws on the biodiversity within globally-wildlife habitats. Involvement Theory add the tourist emotional reasoning or attitude – as motives including time, wildlife seen, cost, and tourist energy expended at the wildlife destination. These theories establish a wildlife and environmental study and questionnaire focus.

At destination, the tourist adorns/consumes the provided wildlife contact offerings. This involvement enlists preconceived expectations. The tourist participates in engaging activities and so develops individual (personal) behavioral opinions (Ratchford & Vaughn, 1989).

During a wildlife tourism experience some tourists note a perception change as they move from expectations to consumption to reflection. This aligns to Users-Gratification Theory, and to Hamilton and Tee's (2015) motives, consumption, gratification relational pathway model. Here, a perceived involvement motive, along with subsequent consumptive experiences and activities can deliver a satisfaction perception concerning the destination and its wildlife (Fodness & Murray, 1997; Vogt & Anderick, 2003). Theory supporting this arises from the Theory of Planned Behavior and the behaviorally-based Users and Gratifications Theory.

METHODOLOGY

The research team deployed a network-reasoned study approach as outlined in Figure 1. This network process encompassed node revisits, and item refinements.

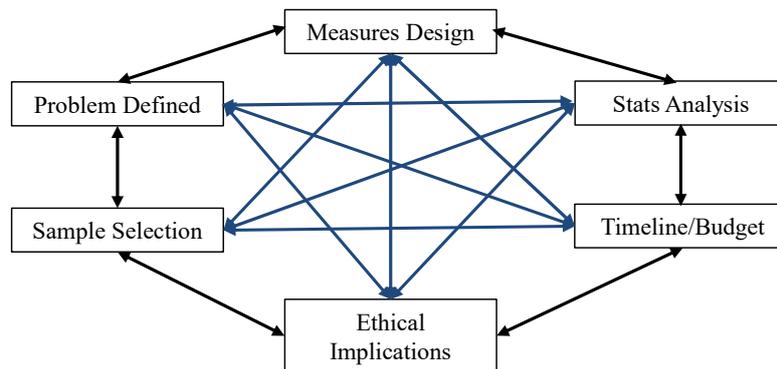


Figure 1: Research planning framework. Source: Adapted from Sapsford, 1999.

Data collection involves 4 steps. First, a review of literature and reports framed the study. Second, a researcher-conducted, in-depth interviews of 15 persons representing tourists, conservationists, and tour operators helped understand: (1) tourists and wildlife experiences, (2) the level of interaction with tourists, and (3) sources of information for wildlife management). Third, focus groups refined the qualitative approaches into specific relational themes including: (1) conservation of wildlife and habitat, (2) wildlife activities and experiences (3) efficacy of the tourism venture, (4) additional habitat sustainability needs, and (e) conservation issues). Fourth, this information coalesced into a (15-20 minute) qualitative-quantitative survey designed to capture why tourists hold certain perceptions. This approach gathered specific and qualitative wildlife destination data from international tourists visiting Sabah through the Kota Kinabalu International Airport (KKIA).

Some studies of different wildlife tourism markets and tourists are shown in Table 1. This table suggests the demography of wildlife tourists typifies those who are often independent, educated, middle aged and financially able to travel and spend, and likely find accommodation around such locations. Hence the survey captures these items.

Table 1: Past tourist studies of different wildlife tourism markets.

STUDY	MAJOR RESULTS
Boxall and McFarlane, 1993 (Canada bird count participants)	Wildlife tourists were more likely to: be older, have higher education levels
Pearce and Wilson, 1995 (NZ International tourists)	Wildlife tourists were more likely to: stay longer, travel further, spend more, be younger. have higher education levels and incomes. be independent travellers
Moscardo, 2000 (Australia Whitsundays tourists)	Wildlife tourists were more likely to: stay longer in the region, be independent travellers
Fredline and Faulkner, 2001 (Australia International visitors)	Wildlife tourists were more likely to: be younger, travel further, stay longer, be on a package tour
Moscardo <i>et al.</i> , 2001 (Australia Tasmania tourists)	Wildlife tourists were more likely to: be female, be younger, independent, longer stay, use the Internet for information

A substantive collation of the early literature closely related to quality tourism experiences is credited to Gayle Jennings in her literature collation (see Ch 1 of her Quality Tourism Experiences publication). The measures (tourism: product quality; experience quality, satisfaction, tourist experience management versus environs, service delivery and qualities, tourism sustainability, host-tourist relations, profitability, experiences, identity and place, and tourism motivation) helped frame this survey's items.

Sabah Study Approach

Sabah State in Malaysia occupies the NE of Borneo Island. It is bordered by several seas including the: Celebes Sea, South China Sea, and Sulu Sea. Since 1995, Sabah's richness of diverse habitat resources, along with its protected wildlife areas, have combined to form a globally recognized regional premier tourism destination. This richness of sea and land biodiversity has now placed Sabah among the top global eco-tourism destinations.

Under the Sabah Wildlife Department, there are 13 differentiated wildlife-based tourism options. Hence, Sabah holds appeal to tourists seeking activity-based destination-emersion attractions, as opposed to those seeking passive destination experiences (Sabah Wildlife Department, 2008).

DePoy and Gitlin (1998) note what constitutes significant knowledge and criteria are derived from different research perspectives and these show variation from one-to-another. Table 2 presents this study's research methodology boundaries.

Table 2: Research methods applied (Saikim, 2019).

TREND TOPIC	RELEVANT REFERENCES
Quality of products (imp. tourism experiences)	Onome, 2003; Weber & Roehl, 1999; Laws, 1998; Murphy, 1997; Vaughan & Russell, 1982
Quality tourism experiences & satisfaction	Yuksel & Yuksel, 2001; Laws, 1998; Murphy, 1997; Chadee & Mattson, 1996; Uysal et al., 1994
Consequences for quality tourism products: quality tourism experience, tourist experience management vs associated environs issues, degradation of environs (marine, cities, terrestrial, heritage sites)	Bhat, 2003; Lawson et al., 2003; Boyd, 2002; Font, 2002; Schneider, 2002; Bauer & Chan, 2001; Harborne et al., 2001; Ross & Wall, 1999; Mak & Moncur, 1998; Murphy, 1997; Ayala, 1996; Moscardo, 1996; Weiler & Davis, 1993; Laws, 1991; Vaughan & Russell, 1982; Smith & Webster, 1976
Service delivery & quality	Warden et al., 2003; Lennon & Harris, 2002; O'Neill et al., 2002; Ryan, 2002; King, 2001; Keane, 1996
Quality tourism experiences & reputation	Boyd, 2002; Font, 2002; Ross & Wall, 1999; Cooper & Morpheth, 1998; Moscardo, 1996
Quality tourism experiences & sustainability	Perdue et al., 1999; Cooper & Morpheth, 1998; Timothy & Wall, 1997; Howell, 1994
Quality tourism experiences & host-guest relations	Neal et al., 1999; Perdue et al., 1999; Howell, 1994; Kim, 2002
Quality of life	Ayala, 1996; Braithewaite, 1992
Quality & profitability	Ryan, 1997, 2002; Urry, 1990, 2002; Lengkeek, 2001; Cohen, 1972, 1979a, 1988
Modes of experience	Campbell, 2003; Bricker & Kerstetter, 2002; Schneider, 2002
Place and identity	Onome, 2002; MacCannell, 2002; Ryan, 1997; Uysal et al., 1994
Quality tourism experience & motivation	

Surveying Process

A self-administered English language survey (Sarantakos, 1993, captured outbound tourist responses at KKIA. The English language format created minor item understanding limitations (Bradburn et al., 2003a; 2003b, Davies, 1994). A voluntary, one-on-one, brief surveyor clarification offered help in understand a specific item (Blaxter et al., 2001; Hawe et al., 2009).

The literature-based survey items are themed as: (1) perceptions of the experience, (2) conservation perspectives, (3) motivations and expectation, (4) satisfaction with wildlife-based tours, (5) intention of visitation and trip characteristics, along with (6) personal demographics. Table 3 shows the study's qualitative and quantitative characteristics. Some qualitative concepts/items are also quantified to enable further interpretation.

The Statistical Package for the Social Science (SPSS) enabled descriptive analysis (frequencies, means, standard deviations, histograms). Significant wildlife viewing types against other variables enlisted Pearson's Chi Square (Field, 2005; Quinn & Keough, 2002). Five point Likert scale items, non-parametric tests, and Mann-Whitney tests helped determine relative differences with wildlife viewing types (Quinn & Keough, 2002). Factor reduction (varimax, principal components) delivered measurable constructs (Field, 2005). Kaiser-Meyer-Olkin (KMO) adequacy of sampling determined the diffusion (or compactness) of correlations (Field, 2005). Open-ended survey items were coded into Excel (quantitative) and Leximancer (qualitative) Leximancer mappings sought relationships between tourist consumptive, viewing, and differentiation behaviors.

Table 3: Qualitative/quantitative aspects (Adapted: Blaxter et al., 2001 & Creswell, 2003).

METHODOLOGY STEP	OUTCOME
Epistemology	Constructionism
Theoretical perspective	Critical theory, grounded theory
Study boundaries	Time, money, availability of samples, access to situations, gaining co-operation,
Research family	Qualitative & quantitative: mixed methods, fieldwork
Research approach	Survey with case study attributes
Research technique	Questionnaire & face-to-face interviews

ANALYSIS AND RESULT FINDINGS

Demographics

Six hundred and forty six (646) outbound tourists (females 51.6% and males 48.4%) completed survey at KKIA (response rate 41.41%). Tourists in the age group 25-44 years totaled 66.9%. Those aged 15-24 years totaled 18.9%. This tourist age distribution is expected, as it typifies those with personal discretionary funds which may then be deployed into ventures of choice - such as participating in a wildlife experience.

Sixty three per cent (63%) of tourists visited Sabah for the first time, whilst 37% previously visited (N=234). Most tourists are well educated (78.5% with tertiary qualifications, and 20% with secondary or certificate qualifications. Fully independent travel tourists (54%) did not use tour operators - suggesting the majority of KKIA tourists are experienced travelers who likely expect a quality of accommodation, transport and servicing that is comparable to other popular global destinations.

Tourists learned of Sabah's wildlife via: the internet (20.9%), travel guide books (21.1%), and word-of-mouth (WoM) communiques. Hence, management of each wildlife destination operation should offer a globally-competitive, English-

language-version of their website. Additionally the wildlife destination in-situ experiences and activities being offered should aim to enhance the tourist's existing discovery and word-of-mouth expectations.

Many tourists chose Sabah for a unique holiday/tours experience. Across eight options, only holiday (63.8%), time with friends or relatives (13.8%), training and/or research (6.5%), and education (15.9%) categories show substantive reasons to visit. Figure 2 shows the Sabah tourist respondent country-of-residence is globally diverse but most country-of-residence tourists most speak English as either their first or second language. Tourists tend to travel in friendship (29.1%) or family groups (35.5%). Some travel alone (19.9%) or as tour/club members (19.3%). Thus tourists likely share their experiences, and are likely to share their experiences more widely. Hence Sabah's wildlife destinations should aim to provide a quality of tourist experiences and activities that is internationally-acceptable.

Forty nine per cent (49.1%) of tourists hold technical or professional jobs, 27.5% are in management or administration, retirees' total 4.1%, and students and unemployed fill the remaining job roles. This indicates most wildlife tourists are financially well-placed to afford these time-consuming, at-destination wildlife experiences. It also suggests accommodation, transport, and associated-services should all be of a consistent high quality, and not be aimed at a lowest price solution. Therefore, the promotion of Sabah wildlife destinations should target well-educated, 'experienced' tourists seeking an international holiday of note, and should use information channels such as: WoM, key global tour-guide channels, and the internet (including social media). Further English should be a key language deployed in such promotions.

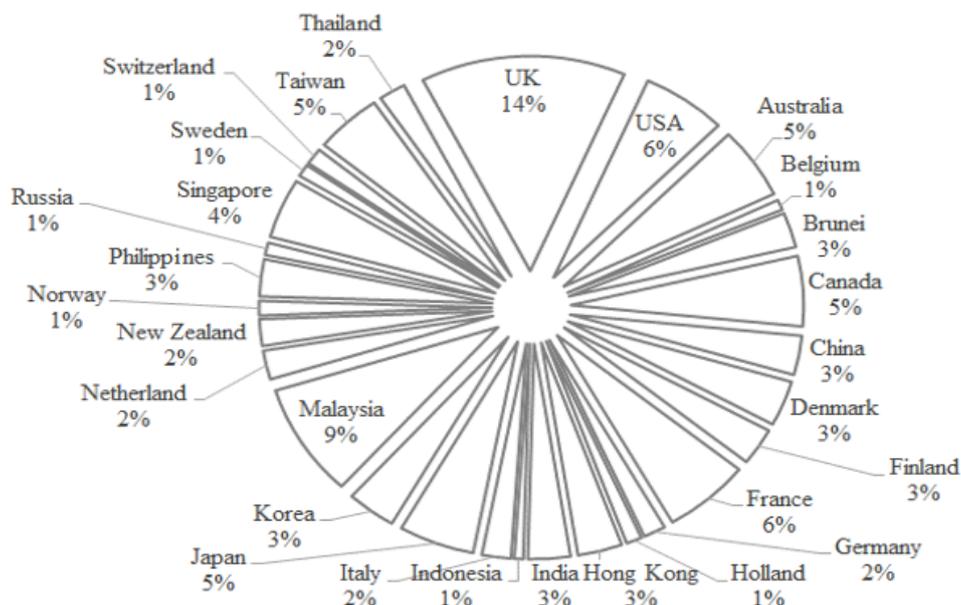


Figure 2: Tourist country-of-residence.

Table 4 summarizes the tourists' prime reasons to visit Sabah. Results suggest wildlife and adventure-based tourism activities are substantive drivers of Sabah tourism, and so should be specially targeted when Sabah tourism improvements are planned.

Table 4: Tourist motives to visit Sabah's wildlife/adventure destinations.

TOURIST MOTIVE ITEMS	MODE	MEAN	STANDARD DEVIATION
To see Sabah's wildlife	5	4.51	0.71
Visit the rainforest/nature parks	5	4.36	0.93
To view endangered species	5	4.30	0.82
Visit the marine park	5	4.26	1.00
Price matched budget	4	3.95	0.90
Adventure activities	5	3.77	1.06
Experience traditional culture	4	3.51	0.96
Rest and relax	4	3.35	1.03
Shopping	2	2.84	1.02
Visit friends/relatives	2	2.37	0.67
Business/conference/meeting	2	2.02	0.64

Table 5 shows most tourists who visited Sabah expected to see wildlife, whilst some (7.1%) also expect to experience traditional culture.

Table 5: Respondents' expectation prior to visiting Sabah, Malaysia.

EXPECTATIONS	FREQUENCY	PERCENTAGE (%)
Endemic species of Sabah	279	43.2%
Abundance of wildlife	135	20.9%
Diversity of wildlife	106	16.4%
Rainforest of Sabah	80	12.4%
Sabah's traditional culture	46	7.1%

Only 1.9% of tourists felt they saw less than they expected whilst visiting Sabah and its wildlife destinations. In contrast 19.2% note Sabah exceeded their expectations. Thus, expectations are generally met during the tourist's stay in Sabah. Tourists most prefer Kinabatangan (18.9%) and Danum Valley Conservation Area (16.6%). These destination offer high wildlife experiences and activities and are considered of high importance to tourists when visiting Sabah through KKIA.

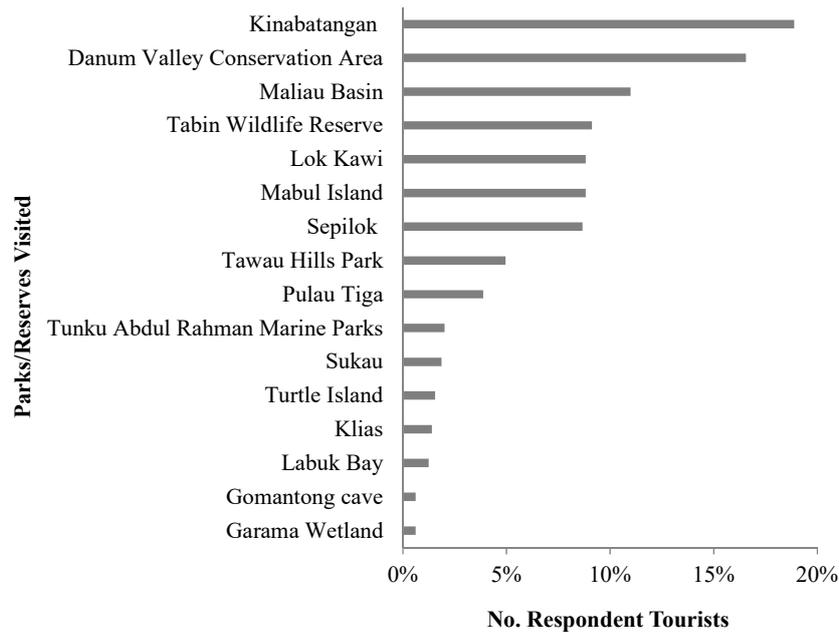


Figure 3: Parks/Reserves/Locations visited by tourists.

Experience Perceptions

Responses from open ended questions are categorized and scaled into Table 6.

Table 6: Perceptions of best (+ve) and worst (-ve) aspects of tourist visits.

POSITIVE EXPERIENCE	RATE	NEGATIVE EXPERIENCE	RATE
Tourist perception (N =646)		Tourist perception (n = 447)	
Preservation/conservation	91.6%	Hardly seen any wildlife	90.2%
Learning	90.3%	Lack of time	78.5%
Scenery	87.8%	Insects/leeches bad encounter	67.3%
Awe and wonder	70.6%	Inexperience guide	66.4%
Organization	46.6%	Weather	45.9%
Relaxation	35.8%	Language	33.1%
Wildlife	31.4%	Tour size	25.5%
Waterfalls	25.1%	Food	15.0%
Challenging	18.3%	Roads	12.5%
Pristine	18.3%		
Safety	18.0%		
Comfortable accommodation	14.9%		
Fun	13.5%		
Rivers	11.6%		

Table 6's top four positive experiences represent a priority tourism promotion target for Sabah's wildlife tourism operators, and the top four negative experiences need resolutions. Tourists clearly want preservation and conservation of these tourism sites (91.6%), scenic realities (87.8%), added learning (90.3%) during their visit, and to capture a sense of wildlife awe/wonder

(70.6%). Those operating Sabah's wildlife tourism destinations should focus on these wildlife experiences as destination areas-for-optimization, and for inclusion in Sabah's wildlife destination marketing. The negatives of Table 6 should also be addressed.

Wildlife Species Preference

The most popular (and iconic) species across Sabah, Malaysia is the orang utans (great ape) (25.9%). Despite the small population (< 40) the Sumatran rhinoceros also rates highly (16.7%) amongst tourists.

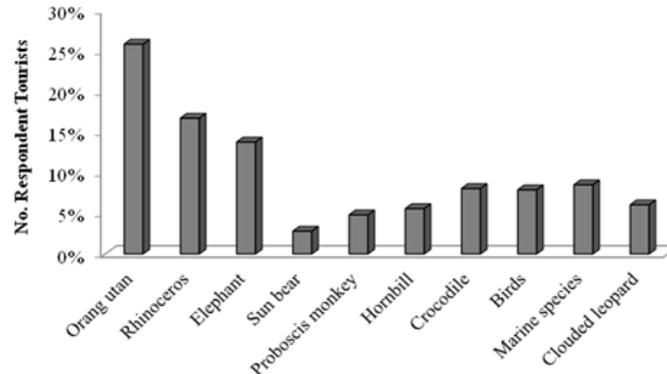


Figure 4: Wildlife species preferences of tourist.

Tourism Experience

Table 7's seven different aspects of wildlife-based tourism experience show viewing Sabah's endemic animals in the wild as a most important experience, followed by seeing a diversity of rare/endangered animal species within Sabah.

Table 7: Respondents' recognition of different 'wilderness' experiences in Sabah.

KEY VIEWING ASPECTS	MODE	MEAN	STD DEV
See animals native to Sabah	5	4.37	0.79
See animals in the wild	5	4.04	1.20
See animals in zoo	4	3.54	0.99
See rare/endangered species	3	3.52	0.88
See many different animals at once	2	3.1	1.08
See animals from across the world	2	2.59	0.69
Learn about animals in museums	2	2.15	0.46

Table 8 shows factor reduction with KMO (sampling adequacy) = 0.731, with no removal of items, and with Bartlett's Test of Sphericity significant ($p = 0.000$). The 'wild' construct captured 42.4% of its variance, whilst the easy-view 'endemic' (zoo) construct captured 51.1% its variance. The items within each construct represent reasonable perspectives for tourist as they consider what is 'wild,' and what is 'endemic.' This suggests tourists do differentiate wildlife.

Table 8: Factor construct loads of tourist animal experiences in Sabah.

ITEM MEASURES	FACTOR 1 (Loading)	FACTOR 2 (loading)
Questionnaire Factor*	Wild	Endemic
Learn about animals in museums	0.75	
See animals native to Sabah	0.73	
See rare or endangered species	0.65	
See animals in the wild	0.42	
See many different animals at once		0.78
See animals in zoo		0.69
See animals from across the world		0.67
Number of items	5	4
Eigenvalue	2.96	1.01
% variance explained	42.3%	14.4%

Tourist Satisfaction

Table 9 shows the very high level of satisfaction of the tourists with wildlife tourism experiences. The Sabah tourist's acquired satisfaction levels are segmented against their perceptions, and against the wildlife service-quality instrument WILSERV. WILSERV engages: (1) reliability, (2) tangibles, (3) responsiveness, (4) assurance, (5) empathy, and (6) wild-tangibles of wildlife destination visitors as its quality constructs (Hendry & Mogindol, 2017).

Table 9: Tourist satisfaction across wildlife tourism experiences in Sabah.

MEASURES	WILSERV-QUAL	SATISFIED	NOT SATISFIED
Vegetation condition	tangible (wildlife)	96.4%	3.6%
Species availability	tangible (wildlife)	95.5%	4.5%
Species diversity	tangible (wildlife)	92.9%	7.1%
Scenery	tangible (wildlife)	95.5%	4.5%
Accommodation condition	tangible (features)	95.5%	4.5%
Information centres	tangible (features)	95.8%	4.2%
Facilities	tangible (features)	95.7%	4.3%
Road condition	reliable (conditions)	96.8%	3.3%
Hospitality	reliable (conditions)	96.3%	3.7%
Convenient business hours	reliable (conditions)	96.4%	3.6%
Sign-posting	empathy (assistance)	95.8%	4.2%
Food	empathy (assistance)	95.5%	4.5%
Safety measures	empathy (assistance)	96.0%	4.0%

In this study, four wildlife WILSERV quality constructs also contribute towards satisfaction. The items providing these four WILSERV quality constructs Table 10 'item-parcels' (Hair, et al., 2010) these items, and a multiple regression – is then mapped against these peripheral satisfaction drivers. This regression relationship is shown as Equation 1.

Table 10: WILSERV quality constructs and measures.

WILSERV-QUAL	MEASURES	WILSERV-QUAL	MEASURES
Reliability	Road condition	Tangible - wildlife	Vegetation condition
	Hospitality		Species availability
	Convenient business hours		Species diversity
Empathy	Sign-posting	Tangible - other features	Scenery
	Food		Accommodation condition
	Safety measures		Information centres
			Facilities

Equation 1: Sabah's wildlife service quality relationship

$$\text{Peripheral Satisfaction} = 1.8(\text{Reliability})^* - 1.6(\text{Empathy})^* + .05(\text{Tangible - wildlife})^* + 0.07(\text{Tangible - other})^* \quad (1)$$

(* = significant at $p < 0.05$)

Equation 1 suggests that when Sabah's reliability, tangible (supporting) features, and wildlife-in-habitat are each jointly considered by the tourist, then the tourist's overall satisfaction is raised. However, the peripheral empathetic items of Table 9 do not positively influence satisfaction. This regression approach can likely be improved in future studies as it currently represents a diverse array of loosely-connected, peripheral tourism items,

Leximancer Cluster Studies

The Figure 5 Leximancer cluster of relationship bubbles shows tourists specifically link key wildlife species, such as the orang utans (Sabah's great ape), as an association with other wildlife, animals, monkeys, 'long tongues,' and adventure. Tourists then closely link these wildlife associations with their adventure-based activities/experiences.

Tourists are also sufficiently perceptive to differentiate these above ape-related species from other Sabah wildlife tourism activities that are water or islands based. Thus, tourists do successfully differentiate and group their wildlife experiences, and they do note each type of wildlife tourism is differently focused.

Figure 6 shows strong dangerous and aggressive wildlife, like Sabah's orang utans (great ape), is secondly perceived by tourists to be amazing, fascinating, rare, interesting, colorful, beautiful, animals, and thirdly perceived as intelligent and human-like. Thus, tourists exhibit a staged observation of wildlife tourism in the natural environment. First, they note the danger, then the wildlife features and characteristics, and then they run personal (innate) comparisons.

Tourists do not perceive such key apex-predator wildlife animals as cute, fluffy, and baby-like. Tourists also recognize apex predator wildlife animals as potentially dangerous, and ones not to be disrupted when being observed in their natural wildlife habitat. Thus, tour guides and the destination's workforce can effectively reach tourists by sequentially staging their presentations as: danger-related, then features-related, then characteristics- and differentiation-related, then by dominance behavior- related, followed by innate comparisons to information and species elsewhere, and lastly emphasizing conservation and a strong respect for the wildlife habitat.

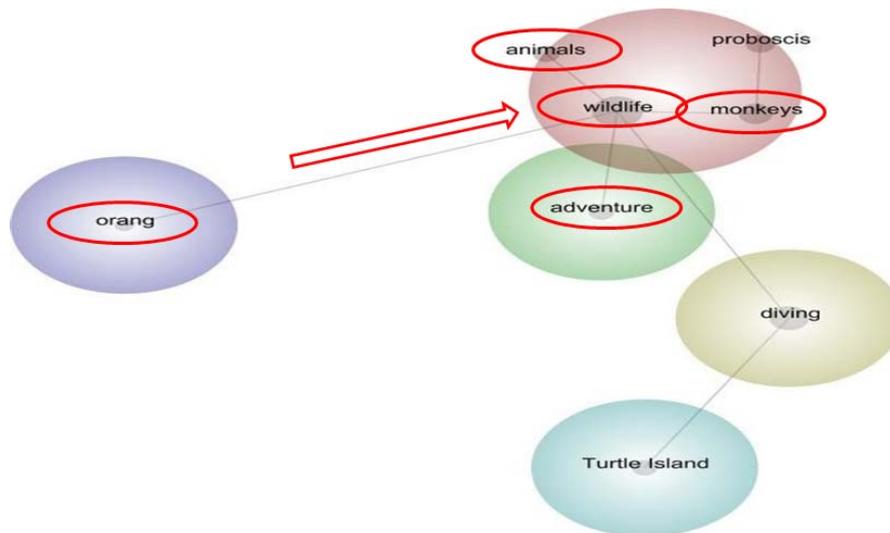


Figure 5: Tourist wildlife and destination relationships (consumption) in Sabah.

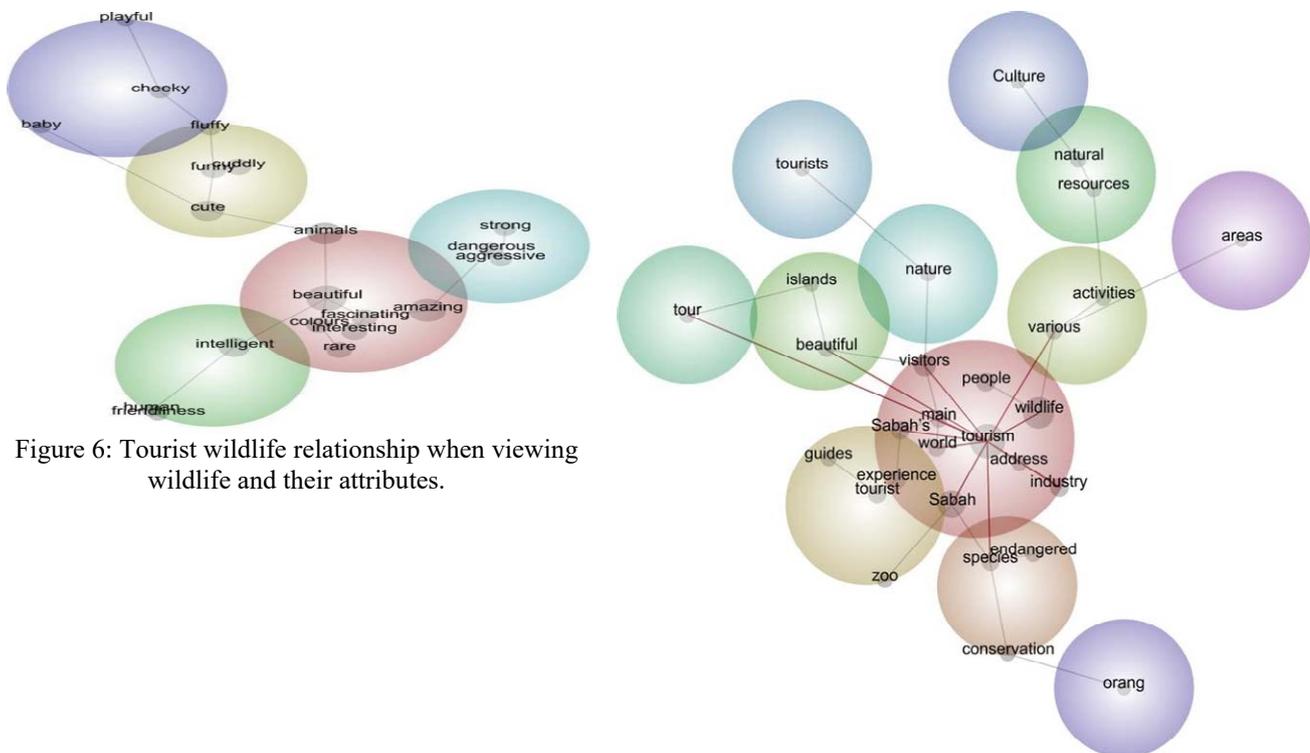


Figure 6: Tourist wildlife relationship when viewing wildlife and their attributes.

Figure 7: Tourist wildlife differentiation perspectives.

Figure 7 shows the qualitative content analysis of 646 open-ended comments shows respondent tourists do perceive relative differences in Sabah’s wildlife destinations. They do differentiate cultural and natural resources as area-specific activities. They perceive Sabah’s orang utans (great ape) as endangered endemic wildlife and ones to be conserved in their natural habitat. They recognize links between iconic wildlife observed activities, experiences, and endangered wildlife properties. They see visiting a zoo or guided experiences are different to an association with the orang utans. They also recognize this Sabah tourist visit has beauty, nature, controlled experiences, activities that that the orang utans is also an intelligent, fascinating, strong, dangerous, intelligent apex predator. They also note this a unique, wildlife, nature-based experience where natural activities arise – and this differentiates it from other wildlife tourism. Such features can be targeted in Sabah’s tourism marketing.

Sabah’s tourists hold different tourism expectations, and these vary in line with their selection of a specific type of wildlife tourism. Thus, it remains important for wildlife tourism destinations to promote their unique features through all possible channels – as these drawcards have recognizable appeal to different tourist target markets. Additionally, because service quality appears important for Sabah’s tourists, consistent monitoring and ongoing conservation efforts around Sabah’s unique wildlife and its embedded habitats remains a tourism ‘product motive’ for ongoing improvements to all Sabah’s tourism-related service quality deliverables.

CONCLUSION

At its biodiversity hotspots, Sabah's tourist animal encounters, and wildlife experiences, do draw tourist involvement and behavioral responses. This study suggests Sabah's tourism informational and operational bodies should consider the travel peripherals (accommodation, food, services, transport, overall cost) as part of the overall wildlife and habitat experience required by wildlife tourists within Sabah.

Wildlife (and adventure-based) tourism activities help drive Sabah's tourism. Many tourists visit nature-reserve wildlife destinations seeking unique experiences and/or related activities. This Sabah wildlife destination study (646 survey) shows respondent outbound tourists passing through KKIA are generally well educated, financially secure, and typically come to Sabah on holiday from their overseas home country.

Tourists generally source information (in English) about Sabah and its wildlife experiences/activities via the internet (and social media), via travel guide books, and via WoM communiques. Hence, Sabah's Wildlife Department, its Tourism Board and Tourism marketing bodies, and its individual wildlife destination management teams should ensure they maintain globally-competitive websites/social media sites offering (1) an English language version, (2) unique adventure aspects, (3) quality holiday services and peripheral perspectives, and (4) international wildlife and habitat conservation appeal.

Leximancer relationship clustering shows tourists link key iconic wildlife - like Sabah's great ape to other endemic and related wildlife. They expand such associations towards adventure-based activities/experiences. Thus, Sabah's Wildlife Department, its Tourism Board and Tourism marketing bodies, and its individual wildlife destination management teams should always present an adventure connotation when presenting their wildlife and habitat deliverables to tourists. Leximancer studies also suggest Sabah's wildlife habitat facilities, and activities, should develop the tourist's expectations by providing staged wildlife-awareness information, and immersive situational experiences.

When Sabah tourists see iconic wildlife - such as its orang utans or rhinoceros, as a wildlife immersion mix (conservation-experience, destination and species education, habitat awe-and-wonder), then an overall tourist satisfaction likely results. They also recognize Sabah's great apes as a dichotomy (strong dangerous/aggressive - yet also amazing, fascinating, rare, interesting, colorful, and beautiful). They observe that these great apes are intelligent and human-like - but unique, special, and unpredictable. Thus, Sabah's wildlife tourism destinations should globally promote their uniqueness features through available physical and virtual communications channels.

Tourists evaluate their wildlife destination support features (accommodation, transport, and servicing) against their internal and international perceptions of quality. These peripheral experiences do affect the outbound tourist satisfaction perceptions of Sabah as a destination experience. Equation 1 suggests Sabah's wildlife tourism destination facilities likely require continual monitoring, and realignment (by Sabah's peak conservation/tourism bodies) – especially if any changes in its tourist satisfaction preferences are detected. This study also concludes Sabah's wildlife and natural habitats deliver experiences and activities that may invoke an enhanced overall satisfaction within the tourist.

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Two-Sided E-Market Platform: A Case Study of Cross Border E-Commerce between Thailand and China

(Full Paper)

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ABSTRACT

Cross Border Electric Commerce (CBEC) has become an important e-commerce model allowing local consumers to purchase products from international suppliers through CBEC platforms. However, in order to synchronize and coordinate the transactions between international sellers and local buyers, CBEC stakeholders need to build an online platform that link between the demand and supply markets. Thus, the Two-Sided Platform models where both buyers and sellers on both sides can share necessary information to promote a synchronous and coordinated market transactions. The two-sided platform can enable streamline coordination of products information, pricing and logistics transactions which could result in an optimal end-to-end CBEC supply chain activities. CBEC stakeholders such as suppliers, consumers, logistic and warehouse companies can gain advantages by expanding the network externality where all parties share relevant information with one another through the two-sided platform. In this study, we conducted interviews with stakeholders who are a part of CBEC trade for Durian and Cosmetics; two of the most popular products from Thailand for the Chinese CBEC market. The study concludes with the need from both demand side and supply side to have an end-to-end coordination. Thus, a supply side or the seller market platform need to be created and link with the demand side platform. Also, in order for supply side market to be created and sustainable in the long run. There are four factors that must be involves in the process 1(government support, 2(Supply Chain Coordination, 3(Online Platform Design ad 4(CBEC Customer Marketing Strategies.

Keywords: E-Business, Cross Border E-Commerce, Two-Sided Platform, E-Logistics

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INTRODUCTION

The global electronic commerce (E-Commerce) market has reached unprecedented level in the last two decades. According to Emarketer, the value of global e-commerce could reach 3.5 trillion U.S. dollar in 2019 (Emarketer, 2019). The phenomenal growth caused by increases in service quality of e-commerce services, improve product delivery time, affordable and wide variety of products, shrinking in digital divide with high speed internet penetration to citizens around the world as well as increases in digital literacy among consumers are some of the important factors that play the roles in the growth of global e-commerce (ESCAP, 2018, Ho, Kauffman, & Liang, 2008). Relevant stakeholders from both public and private sectors have also been adapting to e-commerce phenomenal with new and innovative ways to gain new customers from both local and global markets. Firms try to reach new customers in both local and global markets through channels that were not in existent before the rise of e-commerce popularity. Advancement in high speed internet through fiber optic, 4G and the upcoming 5G infrastructures has also allow businesses at all levels to thrive by providing products and services to their customers whom can buy products and services ubiquitously through their smart phones. Manufacturers also produce innovative products and services that cater to both mass and individual customers with assistance from advanced in IT technologies and big data analytics (Bi & Cochran, 2014, Benabdellah, Benghabrit, & Bouhaddou, 2016). Logistic companies improve their operations which results in improve in delivery time and services quality through lean supply chain management practices and technologies (Tiwari, Wee, & Daryanto, 2018).

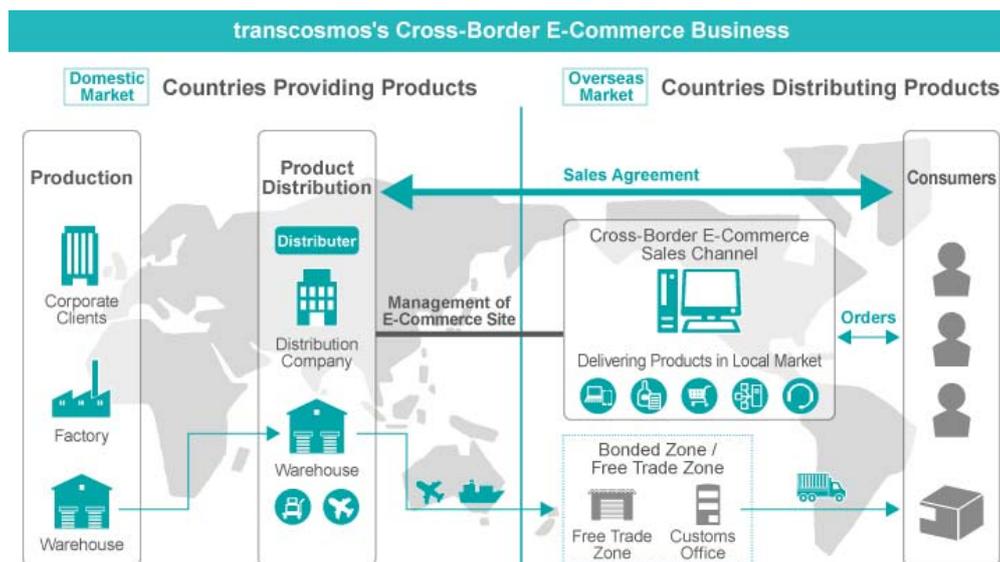
Although, the level of e-commerce innovation and operations have improved drastically with growing examples from e-commerce giants such as Amazon, Ebay, Walmart, Schwarz, Tesco and Alibaba, the stakeholder from the public sector; such as government and tax agencies are still adjusting to the new paradigm where different forms of business transactions between sellers and buyers have changes rapidly both at the local and international levels.

With the growth of total value of e-commerce market increase to 3.5 trillion U.S. dollar in 2019, as there are increases in numbers of business transactions between buyers and sellers, governments around the world have started collecting e-commerce taxes, which still posted many challenges for all involve parties. Since e-commerce taxation has been largely overlook by governments for the last two decades due to the economic policies that supports the early growth of e-commerce industry around the world. Much of the government's activities during the last two decades are to provide a high speed internet infrastructures in fiber optics, 4G and 5G technology to the population. The advances in high speed internet around the world and the lower cost and increase in popularity of smart phones have play important roles in promoting the e-commerce activities which results in the blossoming of e-commerce business models and new and innovative types of transactions. However, there

are still many unresolved issues in regard to how e-commerce can affect the overall population. Issues such as sharing economy and its effects on society i.e. Uber and AirBnB and for an e-commerce industry in the issue of taxation or lack thereof. One of the most prevalent issue regarding business and tax is call Gray Market Economy which mean an economy that happen for the products that has been sold without relevant parties being charge the sale or import tax. Hence this loophole can be remedy with one type of e-commerce; Cross Border E-Commerce (CBEC).

Cross Border E-Commerce (CBEC)

Cross Border Electronic Commerce (CBEC) is when consumers from one country buy products directly through online import channels from international sellers (Gomez, Martens, & Turlea, 2013). CBEC represent a true form of disintermediation of when the internet was introduced in the past. Buyers and sellers can conduct business transaction with one another without an intermediary party. It shows strong potential for both buyers and sellers to gain benefits from the business transaction conducted through CBEC channels. Sellers can expand their customers base beyond their local areas and search out to untapped market beyond their geographical border in an international market. Buyers can buy products or services from international market from the leisure of their own home or from their smart phone. Figure 1 shows the basic CBEC transactions between the buyers and sellers through an online CBEC platform.



Source: Bingbing Chen, 2017

Figure 1: The basic CBEC transactions between the buyers and sellers through an online CBEC platform

Although worldwide value of Cross Border Electronic Commerce has grown significantly in recent years, its size is still relatively small when compare to the total value of the overall traditional E-Commerce industry. However, the CBEC market in China has been growing at a significant rate. China has one of the largest e-commerce markets in the world totally 1.03 USD trillion in 2018 (PwC Analysis, 2018). Hence, the Chinese market has been very attractive for international entities to conduct their businesses especially through e-commerce channels. In 2018 CBEC generated RMB 7.6 trillion (US\$1.1 trillion). By 2020, eMarketer projects that 25% of Chinese population will be shopping online for overseas products via cross-border e-commerce websites (eMarketer, 2019). Also, the growing number of outbound Chinese tourists has also grown significantly in recent years, which subsequently increase the awareness in international products among Chinese consumers. This led to the increase in the demand from Chinese consumers to consume products from international markets such as cosmetics from Korea, high price brand name products from United States, luxury goods from Europe, fruit and herbal products from Thailand, etc. However, since CBEC is still relatively new to China e-commerce consumers, there are still unresolved issues that still need to be investigated and clarify to better understand the CBEC market.

Some of the prominent issues in regard to CBEC market is the alignments of CBEC online platform and its network externalities among relevant stakeholders. In short, how can CBEC market create linkages between network of suppliers, number of platforms, increase the network externalities, improve the logistic performances and dealing with various issues on CBEC taxation.

By connecting all the stakeholders from both demand and supply side through online CBEC network platforms then the trade and transactions of good and services from different market can be achieved (Yousefi, 2015). Furthermore, by having a well-coordinated CBEC market platform, the government can also collect tax from all transactions and subsequently can reduce the number of underground trade transactions or the gray market as well.

In short, CBEC can potentially help lower Grey Market activities where importer import oversea products through cross border channels i.e. at the airports or immigration points in various borders without paying taxes. Some estimate the Grey Market to be worth tens of billions of dollars a year in China, meaning that authorities lose tremendous tax revenue on these transactions. The Chinese grey market is call Daigu. Daigu is a form of cross border commerce where Chinese sellers travel to another country often times in disguise as tourists. Once they come back to China, they would smuggle valuable products back to China without paying custom tax. The Daigu gray market has grown significantly in the last decade where Chinese travelers smuggle products back into china and sell it at the higher price without paying tax. A 2015 survey of Chinese online luxury shoppers found that 35% have used Daigou dealer to purchase luxury goods online, while only 7% used the website of the brand they are buying)Solca, 2015(. Therefore CBEC online platform can provide an official channel for local consumers to buy from reputable brands through CBEC online platform. In order for CBEC platform to be successful in the long run, the platform will need to build and sustain the synchronizations from both supply side i.e. international suppliers and demand side i.e. local customers. Hence a Two-Side Market Platforms need to be established for the ultimate benefit to all parties.

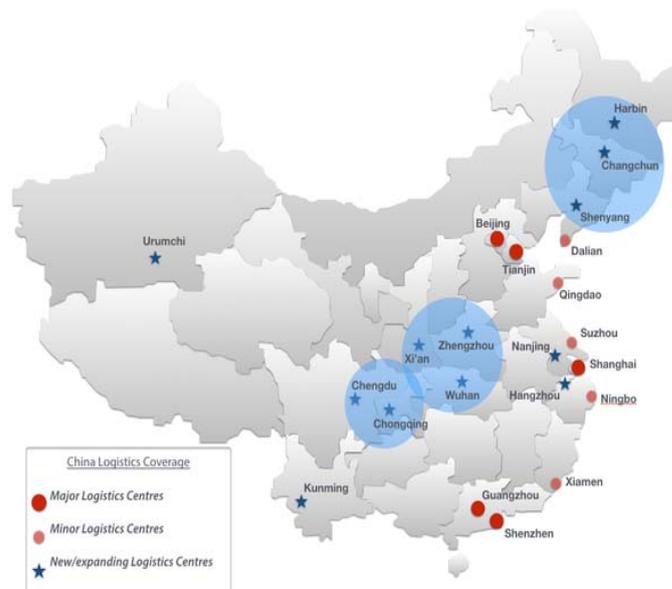
Two-Sided Market Platform

Two-sided market platform is an intermediary platform that provide a facilitating space or features that allow two groups of stakeholders to conduct business transactions)Wismer & Rasek, 2017(. In essence, the two-side market platform enable stakeholder to engage in exchange of good, services and information for all relevant parties. Some of the most popular examples of two-sided market platform is the one where a platform represent an intermediary between supplier and consumers. For example, as more merchant accept the use of e-payment for customer purchases, then more customers would be more likely to use e-payment for their purchases. Hence the more suppliers get involve in the market, the demand could potentially rise as well. Therefore two-side market platform rely heavily on Network effect and Network externality, which mean in order for the platform to become successful, both demand and supply sides need to have a good number of participants or network externality on their side.

In the case of CBEC in China the demand side or the CBEC online platforms market has grown significantly since their inceptions in 2013 and still show strong potentials to grow even more as more customers are buying more products from international market through CBEC platform. Currently, there are many CBEC platform available in China such as NetEase Koala, Alibaba Tmall and JD.com.)Lam, 2018(. Chinese government has also built strong infrastructure through highspeed internet penetrations, advance and affordable mobile smart phones usage rate, wide variety of supplier's startup through Taobao village and towns, as well as strong logistic system that can easily send products across the country within a short time period)Interview, logistic company(. Also, the Chinese government have been active in term of passing favorable laws to help promote CBEC market.

CBEC Pilot Zones

By 2018, Chinese government have set up 13 CBEC pilot zones throughout China. These CBEC pilot zone have set up the bonded warehouses in both tier-1 and tier 2 cities. These zones are located in Shanghai, Hangzhou, Ningbo, Zenzhou, Chongqing, Guangzhou, Senzhen, Tienjin, Hefei, Chendu, Dalian, Qingdao and Suzhou. These bonded warehouses in the CBEC pilot zones act as distribution centers for CBEC products that has been sent to store in the warehouse from international entities. International entities can ship and store their products in the bonded warehouses and then sell their product through CBEC online platform. Once the customers make a purchase from CBEC platform, then they will be charge tax only when there is a purchase order. This allow the foreign entity to lower the risk of not selling their products. Also, Chinese government has made tax exemptions for Chinese consumer with a limited quota per year. In essence, the consumer does not have to pay import tax if they order under a certain limit per year. This strategy is applied for all Chinese consumer who buy from CBEC channels. By having bonded warehouses in different economic zones throughout china, the product delivery time Chinese consumers can be very efficient where CBEC customers often get their order within a short time period i.e. in 1-2 days after they made purchase on CBEC platform. These laws and strategies to help promote CBEC e-commerce to Chinese consumers. Figure 2 shows the CBEC pilot zones.



Source: Ecommerce Worldwide 2017
Figure 2: CBEC Pilots Zones

RESEARCH METHODOLOGY

We conducted case study by employing field works interview, secondary data from stakeholders from both China and Thailand. The secondary data were from newspapers, official websites, national reports and internal company reports and documents that we attained from our interviews. A field works interview is suited to this type of study due to its exploratory nature. To fully analyze the details especially from resources from both countries as well as many involves stakeholders. We had to gather all the sources to make full understanding at both the micro and macro levels. Once we get both primary data from interviews and secondary from other sources, we started to transcribe the interviews and employ professional translation to ensure the validity of the data. Once we finish the transcriptions we also ask three CBEC experts from China to verify the content to ensure that we have translate and transcribe everything correctly from the data set that we obtained during our data collection process. Once the three experts made confirmation with our data sources, we send each of the transcript to the interviewees that we interviewed for the final clarifications before we proceed with the data analysis procedures.

Table 1: List of interviews.

Organization	Title	Products or Services
Goldjet Logistics)China(	Business Development Manager	Medium size Logistic Company
ASEAN Fruits Import Chamber of Commerce)Pingxiang, Nanning, China(	President and CIO	Largest Fruit Importer Organization in China
CTI Logistics)Hong Kong(	President	Medium Size Logistic Company
NetEase Koala)China(	Senior Business Development Specialist	Largest CEBC Platform in China.
Thailand Chamber of Commerce)Thailand(	President	Thailand Chamber of Commerce
Kerry Express)Hong Kong(	CEO	Large logistic company

Case Analysis

Although the demand side market in China has grown significantly in recent years, the supply side is still lacking in many aspects. In our case, Thai stakeholders such as exporters, local farmers, logistic companies and government agency do not have an online platform to showcase their products or services for the export goods to Chinese's CBEC market. Most exporters still operate on the silo-base by individually relying in traditional channels to export their goods. The products displays, marketing, and distributions channels are operating without an online platform. Therefore, the supply and demand is not in equilibrium where both sides need to work together to streamline the process.

We conducted a case study by interviewing relevant CBEC stakeholders from China, Hong Kong and Thailand. We also chose two of the most popular Thai products from Chinese customers who buy from Chinese CBEC online platforms. The two products are Durian and Cosmetics. These are the two products which has the most potential to expand their presence in the

Chinese market. However, there are still few brand selections from Thailand, so we investigated the possibility of exporting these untapped brands directly from Thai suppliers through the Chinese consumers through CBEC channels. First, we interviewed with the President of Thai Chamber of Commerce. We received the overview of exporting Thai products in China.

Thai chamber of commerce has positioned themselves as a centralize organization to help promote the exporting of Thai product to international market and China is one of the most attractive markets according to their internal data analysis. They support Thai suppliers, famers, manufacturers and distributors to increase the number of exports to the Chinese market.

Our interview resulted in the confirmation of the two of the most popular products; Durian and Cosmetics for the Chinese market.

“Thailand export a lot of durian and durian related products to China each year. However, most durian products we sent to China are mostly the most popular type and well-known brands of durian like ‘Mhon Thong’ and ‘Khan Yao’. We try to promote other types of durian through Trade Fairs in China every year. We hope to be able to export more durian to the Chinese market in the future. That is our goal.”

Another interview with ASEAN Fruits Import Chamber of Commerce in PingXiang, China; the largest fruit importer organization in China also confirm the demand for Thai fruits. The president of the PingXiang Chamber of Commerce stated.

“Thai fruit is very popular among Chinese consumers. Some outbound tourists even visit Thailand just to try Durian and Mangosteen. We wish we would get more fruits from Thailand. To be honest, we would take whatever the Thai exporters or gardens have for us, but we have knowledges of where fruit supply are from. We have to send our people to Thailand to search for suitable fruit from different farms and provinces. So most of the time we have to contact the fruit farmer directly. We wish there will be an online platform to answer our need in term of getting more supply as well as the variety of fruit we can import from Thailand.”

Furthermore, the ASEAN Fruits Import Chamber of Commerce PingXiang has stated the need to have an online presence or the online platform for Thai products so they will be able to connect with the suppliers easily as well as having more choices for the suppliers to showcase their products to them before they can import them into China.

“We create an online platform which show information from Thailand side, but we are using it by ourselves. Everything is in Chinese and we try to have English as an alternative language on the side. However, with the language barrier then Thai supplier cannot use our site. Honestly it is very difficult for us to create an online platform that need to have all the necessary information from the local market. Although we have our people in Thailand to look for fruit supply. It will be better to have and E-market place to link the supplier and people in china to exchange information. However, we are in the process of negotiating with Thailand Ministry of Commerce to have a local online platform that is created from the supplier side. Hopefully we’ll be able to work on it together with Thai government soon.”

As for cosmetic product, both logistics companies which also have their own subsidiary platform for CBEC in China also voice their desire to have an online platform for Thai cosmetic so they’ll be able to buy more supply from Thai cosmetic suppliers.

“Thai cosmetic is probably the no. 3 or 4 in popularity among Chinese consumers following only Korean and Japanese in term of popularity of cosmetic products from Asia. In recent years, there are rising popularity in Thai movies and drama amongst Chinese consumer which lead to an increase in awareness and popularity of the cosmetic product for Chinese customers. There are only certain popular brand of Thai cosmetic which is very popular for Chinese consumer. However, their brand such like Snail White has already establish their presence in Chinese market in TMALL. We also want to have some kind of connections with other Thai brands since a lot of our customer love the Thai cosmetics, especially the one that made from natural herb and medicines.”

A logistic company stated the current channel of CBEC practice which is Gray Channel.

“I know a lot of outbound Chinese tourist who visited Thailand often bring a lot of Thai cosmetic back for resale purpose. It is the opportunities for us to import those product and others Thai products for our customer in China. However, we have no ways of knowing what are the best and safe products due to the lack of official online information. I think an online platform should be able to remedy this lack of information problem.”

Although CBEC market from the China has been thriving and a lot of Thai products have been selling well on the platform. There is still need for the demand side market to present the information for their products to their potential buyers. Without an online e-market platform from the supply side, the optimal business transaction between the two sides can’t be complete.

DISCUSSION

In order for CBEC to thrive, both buyers and sellers need to establish a link with each other through an online platform. This platform to connect between supply and demand can lead to an optimal return for both party. By having the platform, buyers can advertise their products and give them local flavor or information where seller can also find wide variety of products that they can also promote through advertising through their channels. Government can also collect import tax from CBEC products and service and ensure the level of, which will benefit their people/consumer in the long run since by having the linkage between both platforms then provide more accountability. For product that's being sold on their site. Although there are existing platforms in Thailand such as different e-market place for agriculture products, none are built as a platform to cater to the CBEC market. Most Thai platforms are small websites or very product specific platform such as agriculture products that only cater to Thai consumers or for small international business entities.

Also most Thai platforms are in Thai or English which does not suit well with the buyer side. The discrepancy in language is also a big obstacle for both party to communicate effectively and efficiently. From our interview, the Chinese entity attempted to build an online platform that cater to Thai supplier, but they were unable to build an effective platform which has both Chinese and Thai language and the main medium for the site. Also, the integrations between local suppliers to the platform can be extremely difficult for the Supply Side platform to try to integrate all players together, since most likely they'll need local knowledges and know-how from Thai side to help build the system. While Thai entities such as Thai Chamber of Commerce and Ministry of Commerce have attempted to build an online platform for their export products, it still hasn't been very successful since they also lack an integration from local suppliers as well as lack the knowledge from the consumer side.

Lack in technology integration also play important role for the lack of the online platform. Although there are some small website and product specific platforms that have been created. It still lack the integration system between all the relevant stakeholders on the supply side. Most existing platform act as a silo base where each entity would come up with their own website or platform without much integration with one another. Although there are attempts from government unit such as Ministry of Commerce to create an online platform for agriculture products it still lack the system integration at a macro level to connect all the party together.

The issues mentioned in lack of standardized platform, language barrier and IT system integration led to a disconnectedness between the suppliers in one country and the buyers from another China. From our interview, most Thai products being sold on China CBEC platforms are usually from the traditional route of importing companies)i.e. NetEase Koala(or the Thai brand has a Chinese establishment in China already)i.e. Tmall(. Thus, the Chinese importers or individual consumers have little or no access to the information from the supplier side except through the traditional route of e-commerce. Hence, this lead to the non-optimal of the demand and supply. The buyer do not have enough information to make decision for the product they may want to buy. Therefore, we proposed that there should be a supply side e-market platform as well. This supply side market platform can consist of manufacturer, warehouse operator, products owners)i.e. farmers(, retailers, distributors and logistic companies as well as other stakeholders that will enable the buyer to be able to look at different products that they want to make transaction or import them the supply side market. By fulling integrate the supply side with the demand side, the two-side e-market platform can play an important role in promoting the CBEC activities. See figure 3 for the proposed Two-sided E- Market Platform.

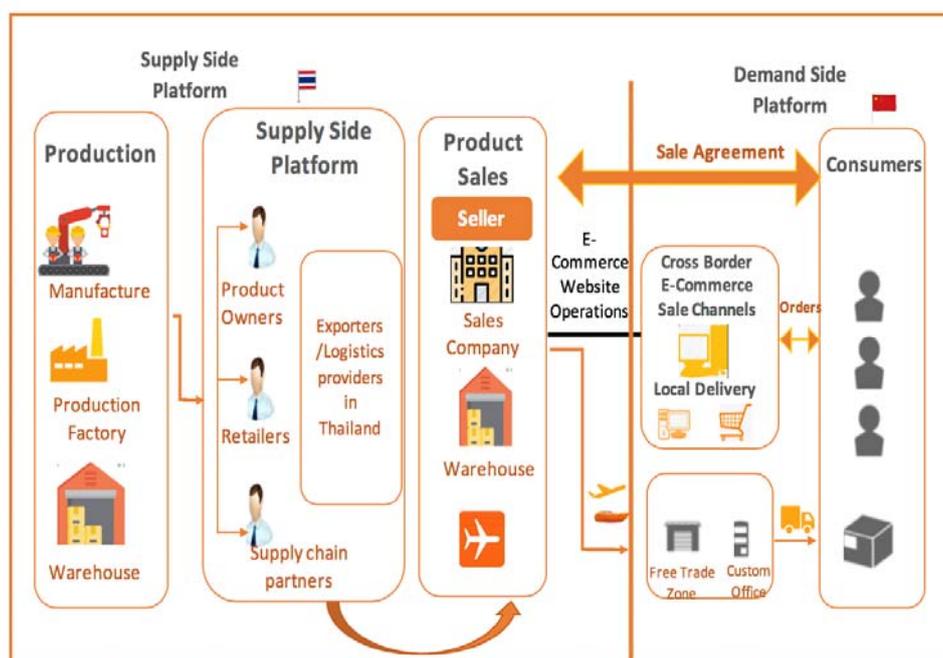


Figure 3: Two-sided E- Market Platform.

By having two-sided market platform, stakeholders from the supply-side in this case Thai suppliers can platform offer products information on the online platform which then the supplier or individual customer from China can browse and shop directly from the platform. This will surely help to improve the awareness of the product availability where the brand doesn't have to be the most popular brand already available in the buyer-side e-market platform. This two-sided market platform will benefit both the sellers and the buyers to fully utilize the marketplace as well as serving the purpose of CBEC where a single customer can have the option to browse and choose different types of product from the seller side where without the Supply-side platform the buyer would have very limited resource in looking for the products they want to purchased.

CONCLUSION

CBEC provide tremendous opportunities for both seller and buyer to conduct e-commerce transactions. However, current form of CBEC in China has only a one-sided online platform mainly from the buyer side. To be able to fully utilized the CBEC original purpose of having the product flow freely from the supplier to the buyers through international market channels, a two-sided CBEC platform must be develop by having the e-market platform on both sides. In order for a supply-side CBEC platform to be built the following issues must be investigated and improve. The relevant issues are as follow:

1(Government support – For the buyer-side CBEC platform, the Chinese government has been supporting in building the CBEC platform by supporting with building the bonded warehouse in 15 pilot zones around China. Also, they have been lowering the import tax for some of the products that is bought through CBEC channel. By having the government support the size of CBEC platform grew significantly and will continue to grow in the future. For the supply-side platform the government such as Thai government need to create a unify CBEC platform where Thai suppliers can have their products display on the platform so the buyers will have the opportunity to look through the product and create transaction.

2(Supply Chain Coordination – The two-sided CBEC platform which link the seller with the buyers in another country should employ end-to-end Supply Chain Coordination where seller can sell their product directly from their location. For examples, a Thai cosmetic producer should be able to ship their product to Chinese consumers by having a full service end-to-end IT integration for the whole transactions.

3(Online Platform Design – in order for CBEC platform to work both the online system should be able to communicate clearly. For example, the seller-side platform must have the language such as Chinese and English for the products. This will lead to the better understanding between seller and buy by getting rid of the language barriers between the two sides.

4(CBEC Consumer Marketing Strategies – in order for the seller to sell their products, they must understand their buyers. Thus an in-depth analysis of their customers will be needed in order for the seller to understand what type of product they can sell and what price point.

Theoretical and Practical Contributions

This study made two types of contributions. First by advancing the understanding of the two-sided market platform by applying it to the CBEC platform in China can help further the understanding of both supply and demand side especially in the IT integration and supply chain coordination. A practical contribution.

LIMITATION

This study was only conducted in two countries; China and Thailand. There are other possibility to explore especially ASEAN regions where China import a lot of their products into their country.

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Virtual World Platforms End-User Motives

(Full Paper)

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ABSTRACT

This study enlists four motive constructs (achievement, control, escapism, and friendship) to show significant differences exist across when applied to different VWs platforms, and shows VW platform studies need to be investigated in isolation, and not in combination. The four motive constructs differ, and in structural equation modelling they can be treated as a combined suite of input motives, and against one VW platform at a time. Such studies offer developers (and relational marketers) direction when formulating and building their VW platform's sustainable positioning modelling outcome directions.

Keywords: End-user motives, gamification, virtual world platform, sustainable positioning, achievement, control, escapism, friendship.

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INTRODUCTION

Virtual Worlds (VWs), Virtual World Communities (VWC), and Social Network Sites (SNSs) have experienced a substantive technological improvement and development in end-user engagement & gamification all over the world (Chung, Nam, & Koo, 2016; J. Guo & Gong, 2011). This has altered the boundaries, the limits, and the scope of VWC (Chung et al., 2016; T. Wang, Yeh, Chen, & Tsydypov, 2016). VWs, VWC, and SNSs each provide a unique yet different platform. Different platforms offer different types and different level of interaction between online global end-users; each does so without restrictions of boundaries, borders, time, or space (Bell, 2008; Novak, Mladenow, & Strauss, 2014).

Virtual Platforms can be defined as platforms where end-users can create and customize personal avatar in a three-dimensional (3D) form that can simultaneously explore, communicate, and interact with the surrounding environment (Nazir & Lui, 2016; Nazir, Lui, & Hamilton, 2016). Such virtual engagement is in addition to communicating with other end-user avatars (Aichner & Jacob, 2015). VWs represent a dynamic new media between virtual participants (avatars) within the virtual community platform.

VWs are becoming a part of some end-users' desires and actions. These desires and actions can generally be described as entertainment, escapism, social interaction, information sharing, achievement, friendship, personalization, and leisure time (Bartle, 2004; Chung et al., 2016; Ridings & Gefen, 2006; Yee, 2006). Marketers remain interested in understanding end-users' motives toward VWs. These new media VW channels can be crafted by marketers when pursuing the delivery of 'compelling messages' directed at avatars that individually represent each of their respective end-users (Jin, 2014).

Virtual world communities are defined as a group of online end-users who form an online relational social network, or relational community (Kannan, Chang, & Whinston, 2000). VWCs can include many forms; (1) blogs, (2) Massive Multiplayer Online-Role Playing Games (MMORPGs) and/or (3) VW environments with new emerging realities such as can be seen in Second Life (SL). End-users in VWCs can possess similar goals, interest, and/or beliefs. For example, many of these end-users share information and VW knowledge and so become further involved across varieties of their social interactions (Chiu, Hsu, & Wang, 2006). Each VW also facilitates, and sets, its resourcing to appropriately support its VWC of end-user members (Chiu et al., 2006).

A VWC's sustainable positioning is geared to the VW developers and their abilities to keep their end-users motivated and interacting across their VW Platform. A VWC's sustainable positioning builds on the virtual platform retention and active participation of end-users (Bock, Ahuja, Suh, & Yap, 2015; Wang, Butler, & Ren, 2013). Many previous VW Platforms grew substantively, but failed, to retain their suite of active users, and so became obsolete over-time (Phang, Kankanhalli, & Sabherwal, 2009). For example, the VW 'SixDegrees.com' launched in 1997, and ceased operation in 2000 (Boyd & Ellison, 2007). Similarly, MySpace (the social media platform leader in 2006) has since been replaced by alternate platforms such as Facebook, Instagram, and others (Tucker, 2019). These replacement platforms remain their agility. They utilize their intelligent mining of consumers' servicing characteristics, behaviors, and values assessments, and so modify, and effectively retain their corporate sustainable positioning (Dai et al., 2014).

Bock, et al. (2015) suggests the understanding of VW end-user motives is likely important when investigating VW Platforms. Others term motives 'an intention to use', and offer varieties of approach considerations - including: attitude, risk, TAM, relative advantage, compatibility, usefulness, expertise, trustworthiness, decision-making, comparative-assessment (Jalilvand et al., 2012, Cantalops & Salvi, 2014, Ayeh, 2015, Agag & El-Masry, 2016, Pappas, 2016).

However as: (1) the above end-user motives, (2) other findings (Constantiou et al., 2012; Y. Guo & Barnes, 2011; Hassouneh & Brengman, 2014; Zhou et al., 2011), and (3) Table 1's summation, do not provide consistent approach considerations, this study now seeks clarification around VW Platform end-user motives. It seeks to contrast different VW Platform types, and to determine whether end-user motives within a particular VW Platform may offer developers insights when pursuing improvements to their particular online VW community's sustainable positioning. Such findings may extend into possibly providing some direction when developers are building a similar VW Platform.

LITERATURE REVIEW

Virtual Worlds

Each VW end-user participate in a VW appears as a 3D animated character - termed an 'avatar'. Here, the real-world, end-user's virtual-world avatar navigates within the aspects and actionable areas of the 3D VW Platform's virtual environment (Girvan, 2018).

The avatar is a constructed graphical representation made by the end-user into a 3D actionable form that then interacts with surrounding virtual objects and other contactable end-user avatars (Liu & Williams, 2008; Nah, Schiller, Mennecke, Siau, & Sattayanuwat, 2011; Tikkanen, Hietanen, Henttonen, & Rokka, 2009). These avatars can sometimes exchange IM, virtual objects and money (virtual money). They may also communicate through texting, voice chatting, display different gestures, by voice conversations and/or by actions (Girvan, 2018; Nazir & Lui, 2016, 2017; Nazir et al., 2016).

Different Virtual Worlds

Tikkanen et al. (2009) grouped existing VWs into four categories; these categories are Static Game World (SGW), Dynamic Game World (DGW), Static VWs (SVWs), and Dynamic VWs (DVWs).

Jung (2011) then classified VWs into SVWs, Mixed VWs (MVWs), and Gaming VWs (GVWs). SL, as the representative of a SVW does contain some gaming activities, but these gaming activities developed by the end-users themselves and not by the developers of SL.

At the operational end, EU, as an MVW, is a dynamic gaming virtual world that also includes a very high level of social activities and collaboration. In 2013, EU listed a moon for development, with management rights bidding started at US\$150,000. The winning moon-bidder is now allowed to operate their own moon in EU (Entropia Universe, 2013; McGlaun, 2013). There are different and extensive differences between social-related and game-related activities across these differing forms of VWs. There are also different features available for creating dynamic-content and/or interactions with other end-users.

WOW, as the representative of GVWs, allow end-users as internal game avatars to just explore the landscape, fight monsters, and complete quests (Calvert, 2010). The virtual currency used on WOW is Gold. In the past, exchange Gold with real money happens illegally, outside the control of Blizzard Entertainment (the WOW game developers).

SL allows end-user avatars to meet, interact, and create individual or group activities in a manner similar to the way activities are conducted in real life, such as going to the cinema, shopping in retail malls, engaging in sport stadium activities and/or participating in education (school or university).

SL resident avatars can earn Linden Dollars by working in SL virtual jobs or by investing in real estate or buy directly by exchanging real money for Linden Dollars (using LindeX exchange market). Virtual currency is then used to purchase different VW items such as clothes and fashion, weapons, property, vehicles and pets. These items are used by the SL end-user to frame their avatar's presence, create the avatar's virtual world and to conduct virtual world business.

From 2003 to 2013, the number of VW end-users in SL grew from a virtual land size of 64 acres to 448,000 acres and expanded to more than 36 million residents. In 2014, there were over 1 million active end-users in SL, with over 1.2 million transactions each day for virtual items (Hendaoui, Limayem, & Thompson, 2008; Linden Lab, 2013). Similarly, VWs such as WOW and EU also experienced significant growth in terms of end-users and size of their respective economies (Gapper, 2006; Nazir & Lui, 2016).

Gaming Virtual World

GVW Platforms encourage team players and group formation - where combined strengths quickly complete some of the quests to win group mutual benefits. These special interest groups work together as guilds to generate competitive high profile within these VW social environments, and they mirror real-life social groups (Zhang & Kaufman, 2015). They require member engagement, commitment, and dedication. Guild players in GVWs fulfil roles within their groups such as killers, or irritants, or preservers. Guild success arises where the group balances and overall dominates across these three members roles (Zhang & Kaufman, 2015). A strong relationship of trust is often developed in such a competitive group environment (Zhang & Kaufman, 2015).

Social Virtual World

In contrast to the competitive gaming of GVWs, SVWs are designed to replicate the real-life experience, thus allowing different types of interaction between end-users along with the extended and unrestricted experience. Here, end-user avatars can craft, buy and sell products and services they can dance, drive, eat, marry, and so forth. Hence, they can live an entire virtual life (Mäntymäki & Salo, 2013; McKenna, 2019; Zhou, Jin, Vogel, Fang, & Chen, 2011).

Hassouneh and Brengman's (2014) list motives for joining SVWs as: making friends, escaping reality, being a role-player, achieving (by developing a revenue-generating business), seeking relationships and/or manipulating others. This fits within Sharma et al.'s (2013) model of VWs end-users' motives as four constructs: technology, social networking, entertainment, and revenue-making.

End-Users' Motives

Motives is an intention aspect of what drives the end-user's activity. It is connected to 'gratifications theory,' which has an impact on individual action (Basilisco & Cha, 2015).

Previous studies find different motives involve different media platforms. Roy (2009) finds a reason end-users choose to use Facebook and Myspace in the US is to 'meet friends' and to 'seek information.' As argued by Hassouneh and Brengman (2014) and Lehdonvirta (2009), many researchers either look at social media networks or VWs, without considering the difference between VWs. They describe reasons for joining SVWs as: to make friends, to escape reality, to be a role player, to achieve (for example, to create a revenue-generating business), to seek friendships, and/or to manipulate others. These constructs also fit within Sharma et al.'s (2013) model of VW end-users motives – including: technology, social networking, entertainment, and making-revenue.

Yee (2006) studied GVWs finding that the motives to join are similar to those in SVWs. Yee (2006) argues that 'achievement,' 'social,' and 'immersion' are the overarching constructs that also motivate end-user's participation

Lin et al.'s (2015) study concludes that end-users of VWs are motivated by achievement values and so seek personal success. They also find that end-users with achievement motives tend to have a stronger social position, and authority, compared with other end-users. "The six achievement values, which include: advancement of wealth and status, victory, socialization ability, self-actualization, fantasy, satisfaction, and adventure, also drive end-user players to successfully meet social standards in MMORPGs" (Lin et al., 2015, P.846).

In developing the study's end-user motives, we first investigate previous research models (Table 1) that apply end-user motives to participate. This study investigates the motives encouraging VW Platform end-users to keep participating in their chosen VW. In their VW, these end-users show less concern about the platform's 'usefulness,' or its 'ease-of-use,' because these existing end-users are already familiar with their VW platform, and they are able to navigate within it, and they are able to actively use its actionable VW areas. However, they are concerned about both the VW Platform's deliverables and its participatory activities. The broad concept 'entertainment' is also difficult to classify. It too is outside the scope of responses from this study's active, competitive end-users, and so it is not included in this study. Hence, this study does not include end-user usefulness, or end-user ease-of-use, or end-user entertainment as a motive driver towards promoting end-user participation into either of the three virtual worlds (SVW, MVW, and GVWs) investigated herein.

Thus, we reduce the seven literature-supported key motives to participate (achievement, control, ease-of-use, entertainment, escapism, relationship (friendship), and useful) down to Table 1's remaining four, relevant, literature-supported, online, VW community participation motives (achievement, control, escapism, and friendship).

VWs Sustainability

Understanding end-users' motives remains important when understanding the target users of a VW, but of key importance is how these motives help build and/or develop an online community sustainable positioning (Bock et al., 2015). Thus, when pursuing the retention and growth of VW platform end-users, VW developers should maintain first enlist the above existing motive constructs, and over-time seek improvements to the motive items listed. These VW developers may even source additional/emergent motive constructs that can expand on this study's findings (see below).

Bock's (2015) study suggests that to improve an active member's experience in the VW, its developers can improve their IT infrastructure and so facilitate increased interaction and collaboration between end-users. This in-turn, can enable end-users to share their VW experience information more effectively, and so build stronger ties with each other (Bock et al., 2015; Nazir, Hamilton, & Tee, 2018). Add-ons, such as also allowing VW users to choose most appropriate collaboration tools (Bock et al., 2015), may offer further VW experience improvements.

Table.1: Grouping End-users' Motives Studies

End-users' Motives	Achievement	Control	Escapism	Relationship (Friendship)
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References	Achievement	Challenge	Role Play	Self-Expression	Financial	Fantasy	Escapism	Individualism	Socializing	Relationship	Information	Friendship
Basilisco & Cha, (2015)									✓		✓	✓
Hassouneh & Brengman, (2014)	✓		✓				✓			✓		✓
Zhong, (2014)		✓				✓	✓					
Verhagen, Feldberg, van den Hooff, Meents, & Merikivi, (2012)					✓		✓					
Barnes, (2011)												
Barnes & Pressey, (2011)								✓				
Partala, (2011)				✓		✓			✓			
Yeh, Chuan-Chuan Lin, & Lu, (2011)									✓			
Zhou et al., (2011)					✓				✓			

METHODOLOGY

Instrument Development

This study investigates different end-users' motives among the different types of VWs platforms. Target participants are active end-users of SL, EU, and WOW. Hence, an online global VW platform questionnaire offers a suitable research design, and allows this study to reach global respondents within its specifically-targeted SL, EU, and WOW participatory communities.

The 2015 online questionnaire was shared globally using the online questionnaire platform called 'Survey Monkey'. The piloted, and validated questionnaire measured items were developed from constructs used in previous studies (Table 1). The online, 5-point Likert Scale (1 = strongly disagree to 5 = strongly agree) questionnaire takes 10-15 minutes to complete. It remained active online for three months. The questionnaire URL was distributed through the SL, EU, and WOW related community platforms, including Facebook groups, forums, and Instant Messaging (IM) within the VWs platforms.

Specifically, achievement motive measurements items are adapted from (Hassouneh & Brengman, 2014; Zhou et al., 2011), control motive measurement items adapted from (Y. Guo & Barnes, 2011), escapism motive measurement items adapted from (Hassouneh & Brengman, 2014; Mackenzie, Buckby, & Irvine, 2009; Partala, 2011), and friendship motive measurement items adapted from (Constantiou, Legarth, & Olsen, 2012; Hassouneh & Brengman, 2014; Suler, 2004). Thus, four targeted motive constructs were enlisted.

Data Collection

The online questionnaire delivered 613 responses. After eliminating duplication, incomplete answers, and inconsistencies, the final usable sample size for this study was 274 responses. This large reduction in response usability was due in-part to many respondents starting the survey and not completing it, or not completing the last demographic section, and/or not completing certain survey sections. Nevertheless, a usable global sample size is obtained.

Factor reduction engaged SPSS 22.0. The motive constructs developed each held all items to item loads above 0.7, residuals below 0.05, and no cross-loads greater than 0.3 existed. Each motive construct exhibited a Cronbach Alpha above 0.6 and held an average-variance-explained measure of above 0.5 (Hair et al., 2010). Hence, all construct items showed internal consistency, and reliable constructs resulted.

RESULTS

Table 2 summarizes the demographics of the study sample across the different VW platforms (SL, WOW, and EU). Overall, the male population (57%) outweighs the female population (43%). About 79% of the VW population is aged 44 years or younger. Thus, those involved-in, and engaging-with, these three interactive VW Platforms tend to be non-gender specific and tend to be within the 18 to 44 years age group.

Demographic Measure (N=274)	Percentage (%)
Gender	
Female	43.1%
Male	56.9%
Age	
18 to 24	23.7%
25 to 34	30.7%
35 to 44	24.8%
45 to 54	14.6%

55 or older

6.2%

ANOVA Results

The study's hypotheses are investigated via ANOVA with post-hoc analysis. Table 3 shows the achievement motive is significant ($p < 0.05$) for SL against WOW, and for EU against WOW, and insignificant for SL against EU. The control, escapism and friendship motives also display significant differences in end-user motives within their respective different VW platforms. SL is different in its control motives, escapism is different in its EU motives, and friendship is different in its EU differences.

These significant differences in motives are understandable, and they can arise because of the differences in the purpose and use of these differing VW platforms, and the type of end-user activities conducted within each VW platform.

Table 3: ANOVA with the Tukey HSD Test for Social Capital (Cognitive, Relational and Structural)

Construct	Main VW	Compared VW	Mean Differences	Std. Error	Sig.
Achievement					
Achievement	SL	EU	.207	.145	0.32
		WOW	.540	.131	0.00
	EU	SL	-.210	.145	0.32
		WOW	.332*	.136	0.04
	WOW	SL	-.540*	.131	0.00
		EU	-.332*	.136	0.04
Control					
Control	SL	EU	.600*	.142	0.00
		WOW	.343*	.129	0.02
	EU	SL	-.600*	.142	0.00
		WOW	-.256	.134	0.13
	WOW	SL	-.343*	.129	0.02
		EU	.256	.134	0.13
Escapism					
Escapism	SL	EU	.349*	.135	0.02
		WOW	-.296*	.122	0.04
	EU	SL	-.349*	.135	0.02
		WOW	-.645*	.126	0.00
	WOW	SL	.296*	.122	0.04
		EU	.645*	.126	0.00
Friendship					
Friendship	SL	EU	.503*	.151	0.00
		WOW	-.200	.137	0.31
	EU	SL	-.503*	.151	0.00
		WOW	-.703*	.142	0.00
	WOW	SL	.200	.137	0.13
		EU	.703*	.142	0.00

* The mean difference is significant at the 0.05 level

CONCLUSION

This study highlights that these four motive constructs (achievement, control, escapism, and friendship) show significant differences when applied to different VWs platforms. It also suggests that VW platform studies need to be investigated in isolation, and not in combination. This study clarifies why past and combined VW platform studies of achievement, control, escapism, and friendship end-users' motives (Constantiou et al., 2012; Y. Guo & Barnes, 2011; Hassouneh & Brengman, 2014; Zhou et al., 2011) have delivered inconsistent (and sometimes unpredictable) findings.

This study suggests the motive constructs (achievement, control, escapism, and friendship) each exert different effects within an individual VW platform. Hence in VW platform studies it likely remains useful to investigate the motive influences of the constructs (and their items) as a combined suite of input motives, and to do so one VW platform at a time. Further, for each VW platform, such end-user motive constructs can be used in structural equation modelling as a suite of pre-engagement drivers that initiate VW behavioral, and/or values, and/or trust/loyalty studies. Such studies offer developers great direction when formulating and building their VW platform's sustainable positioning modelling outcome directions.

Further understanding of such motive constructs also provides VW Platform and gaming developers with potential specific item-focused additions. Sometimes, these item addition considerations may expose further virtual platform 'sustainable

positioning' enhancements, or they may expose relational marketing pathways through which the VW developers may work towards enhancing their end-user and/or potential new-consumer commitments.

Limitations and Scope for Future Research

- The sample size per VW type is acceptable, but relatively small when sectioned into VW platform respondent data sets. Hence, larger sample sizes per VW should allow more in-depth analysis and interpretation.
- This English language only online end-user survey reduces the scope of interpretation. A multilingual survey may contribute further understanding to this study's findings.
- This study did not segment the VW responses against the demographics (age, gender, social status and educational level) or against detectable background differences of the end-users. Further segmentation may likely offer further motive construct and item insights.

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Wildlife Tourist Consumption in Sabah Malaysia: A SEM Path Model Approach

(Full Paper)

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ABSTRACT

This study applies Animal Encounter Theory, Experience Theory, Biodiversity Hotspots Theory, Involvement Theory, the Theory of Planned Behavior, and User-Gratification Theory. It develops a behavioral Tourism Wildlife Behavior Path Model. This path model shows Sabah Malaysia's wildlife destination tourist experiences, and its in-situ tourist activities, do evoke a measurable positive change in the tourist's overall satisfaction level. It also offers management and workers at Sabah's wildlife destinations insight that may be beneficial in developing both wildlife and conservation servicing, along with other educational tourist information perspectives. These may also induce lasting tourist memories, and hopefully generate a lasting tourist loyalty.

Keywords: Sustainable tourism, destination experience, satisfaction, conservation, tourism wildlife behavior.

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INTRODUCTION

Considerable research on the growth and the size of wildlife tourism exists (Barnes et al., 1992; Amante-Helwey, 1996; Barnes, 1996; Roes et al., 1997; Newsome & Rodger, 2013). However, where tourists (domestic or international) pursue wildlife tourism experiences in Sabah, Malaysia there is scant destination information.

Malaysia's Sabah state at the NE of Borneo Island and is bordered by the Celebes Sea, South China Sea, and Sulu Sea. Since 1995, Sabah has developed into a premier tourism destination. Its thirteen diverse sea and land biodiversity attractions offer major wildlife-based tourism destination options and adventures to tourists visiting from across the globe (Sabah Wildlife Department, 2008).

Hence, this study investigates tourist preferences when visiting the protected, thirteen natural vegetation areas in Sabah, Malaysia. It asks the following research question:

'do Sabah's consumptive wildlife-based (experiences and activities) adventures evoke measureable, overall satisfaction changes for the tourist?'

It deploys a theory-supported survey, and it engages a quantitative structural path model approach to elucidate pathways towards overall wildlife destination satisfaction in Sabah Malaysia.

THEORETICAL FRAMEWORK

The themes of wildlife tourism are captured in this study through its data collection items. These build against a combination of the following theoretical approaches: (1) Experience Theory, (2) Animal Encounter Theory, (3) Biodiversity Hotspots Theory, (4) Involvement Theory, (5) Theory of Planned Behavior (integrating reasoned action), and (6) Users and Gratification Theory.

Experience Theory and Animal Encounter Theory set the theoretical framework for animal encounters as a strength level of wildlife experiences. These encounters at a destination may offer sustainable and conservation considerations for participating tourists, the stakeholder, the animal, and the whole tourism industry. Experience Theory allows participating tourists to consider their chosen specific wildlife attraction/activity as a specific experience. Biodiversity Hotspots Theory considers the rich biodiversity within globally-threatened habitats, focusing on their key endemic species. Here, a sustainable (and marketable) wildlife tourism product, that is 'wildlife-friendly,' is supported by the Biodiversity Hotspots Theory.

Involvement Theory captures the attitudinal motives of time, cost, and energy required by the tourist in choosing their wildlife destination and activities. It also defines the tourist's degree of emotional reasoning, feelings, and logic when choosing their wildlife destination's activities and experiences. The above (1) to (4) theories all help build the wildlife and environmental framework against which this study's tourist destination questionnaire items are framed.

A consumptive acquisition process is then built through the stimulation aspects of interest acquired when the tourist participates in such engaging experiences and activities. This consumptive behavior is displayed at wildlife tourism

destinations. It is supported by the Involvement Theory (Havitz & Dimanche, 1999; Gursoy & Gavcar, 2003; Pearce & Kang 2009). Involvement builds direct experiences as an internal, motivated, behavioral-value commitment (Hamilton & Tee, 2015b). This consumptive acquisition process builds a simulation of interest - acquired through participation in engaging activities and experiences. Ratchford and Vaughn (1989) observe involvement helps tourists develop certain opinions that in-turn likely affect their behavior. Animal Encounter Theory, Experience Theory, Biodiversity Hotspots Theory, and Involvement Theory all help build the wildlife and environmental framework against which this study's tourist destination questionnaire items are framed.

The tourist's relations, beliefs and behavior link through Involvement Theory into the Theory of Planned Behavior (Aijen, 1991) - where the tourist applies their reasoned action. Here, a heightened involvement intention (motive) leads the tourist to consume both experiences and activities, and so acquire a new (satisfying) perception of the destination and its wildlife (Fodness & Murray, 1997; Vogt & Anderick, 2003). Thus, the Users (tourists) and Gratifications (reflective behavioral outcomes) Theory (Katz et al., 1973) applies to post-event tourist satisfaction. It also applies when the tourist assesses if a sufficient personal behavioral change has also engendered (1) a sense of trust in the destination's offerings, and (2) a sense of loyalty towards this destination offerings.

Further, when a tourist chooses to come to a wildlife destination, they likely come with a pre-conceived attitude, with a set of pre-conceived norms, and with a suitable behavioral control mechanism. A tourist's expectations regarding their forthcoming experiences and activities then extends into a participation, or user phase. If this participation is deemed of value, then a tourist's participation (user) phase may extend through to an overall satisfaction (gratification) phase (Hamilton & Tee, 2015a; 2015b).

The Users and Gratifications Theory approach also sees tourists within the destination and its wildlife habitat intentionally choosing an aspect of this environment that over their time at the destination likely leads to a consumptive assessment concerning their wildlife knowledge and determinants. This also creates a sense of trust in the tourist's conservation memories and recollection views. It may also lead to a reflective perception around a degree of loyalty (or ongoing respect for) towards this wildlife environment, and all may also culminate into a reflective overall net satisfaction perception about the wildlife destination. Thus, a planned behavior and involvement approach is adopted by this study. This is illustrated in Figure 1 as the proposed wildlife tourism behavior framework for the study.

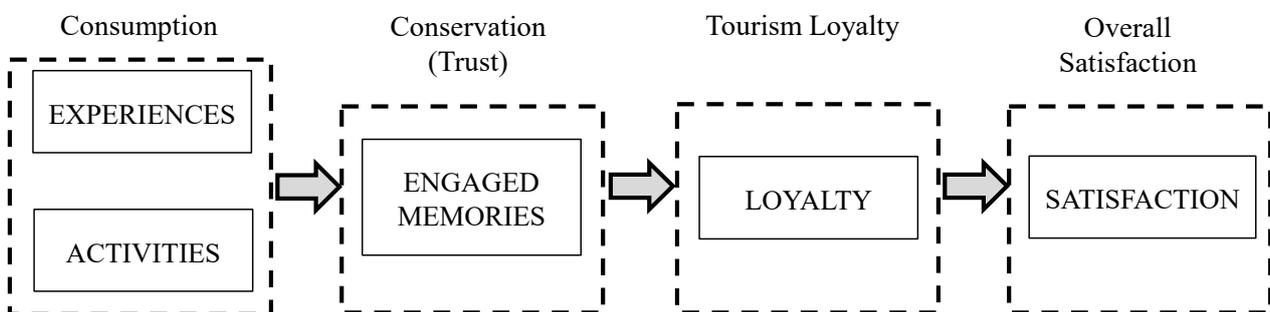


Figure 1: Proposed Tourism Wildlife Behavior Framework.

TOURIST WILDLIFE BEHAVIOR

The initial destination drawcard constructs (activities and experience) supporting a tourist participation are likely consumptive (Coghlan & Prideaux, 2009). Hence, a destination likely needs to provide activities, wildlife species, environmental attributes, and behavioral opportunities that facilitate a tourist preferencing towards the wildlife tourism context (Newsome et al., 2004). Such responses should be physical, as well as behavioral (Kellert, 1996; Plous, 1993; Eddy et al. 2001; Tremblay, 2002).

Table 1 presents key tourist engagement characteristics. These are primarily experiential and they are also likely destination-specific. For example, in Sabah, Malaysia, tourists are exposed to protected wildlife conservation programs. Here, they may be offered a variety of protected species movements, environmental sensory walks, endangered animal behaviors, and feeding stations - as well as education! This controlled-environment reduces habitat damage, promotes survival of endangered species, and promotes conservation among tourists (Syamlal, 2002). It also reduces poaching, and other destructive human activities (SWD, 2010).

In studies of the conservation of wildlife species, a key determinant is understanding what creates overall tourist satisfaction. A tourist who actively experiences positive wildlife encounters, likely shares such destination experiences, and may also revisit. Over-time this increases the awareness of wildlife and helps build long-term global conservation values towards species (Shackley, 1996; Moscardo & Saltzer, 2004; Newsome et al. 2004; Higginbottom, 2004). Thus, from the above discussion, this study proposes the Tourist Wildlife Behavior model shown in Figure 2.

Epistemology

Primarily, this research examines the interaction between the respondent and the setting (destination), and how the wildlife-based experiences characterize such interaction. Hence, constructionism is a suitable epistemology for this research. Constructivism examines how tourists construct different meaning in different ways in relation to the same studied phenomena (Crotty, 1998). It relates objects or events viewed by a respondent and delivers study meaning (Rubin & Rubin, 2005).

Table 1: Wildlife Tourism Characteristics (Saikim, 2019).

CHARACTERISTICS	REFERENCES
Seeing wildlife in natural environment	Moscardo & Saltzer (2004), Duffus & Dearden (1993), Schanzel & McIntosh (2000), Moscardo et al. (2001)
Wildlife behaving naturally	Moscardo & Saltzer (2004)
Rare and unique wildlife	Moscardo & Saltzer (2004), Reynolds & Braithwaite (2001), Shackley (1996)
Large variety of wildlife	Moscardo & Saltzer (2004), Higginbottom (2004), Hammit et al. (1993), Moscardo et al. (2001)
Easily seen wildlife	Moscardo & Saltzer (2004)
Presence of infants	Schanzel & McIntosh (2000)
Human-like	Tremblay (2002), Plous (1993), Eddy et al. (2001), Moscardo et al. (2001)
Large	Shackley (1996), Davies et al. (1997), Johnston (1998), Sagan & Marguils (1993), Newsome et al. (2004)
Popularity of the species	Reynolds & Braithwaite (2001)
Aesthetic appeals	Tremblay (2002), Kellert (1996), Newsome et al. (2004)

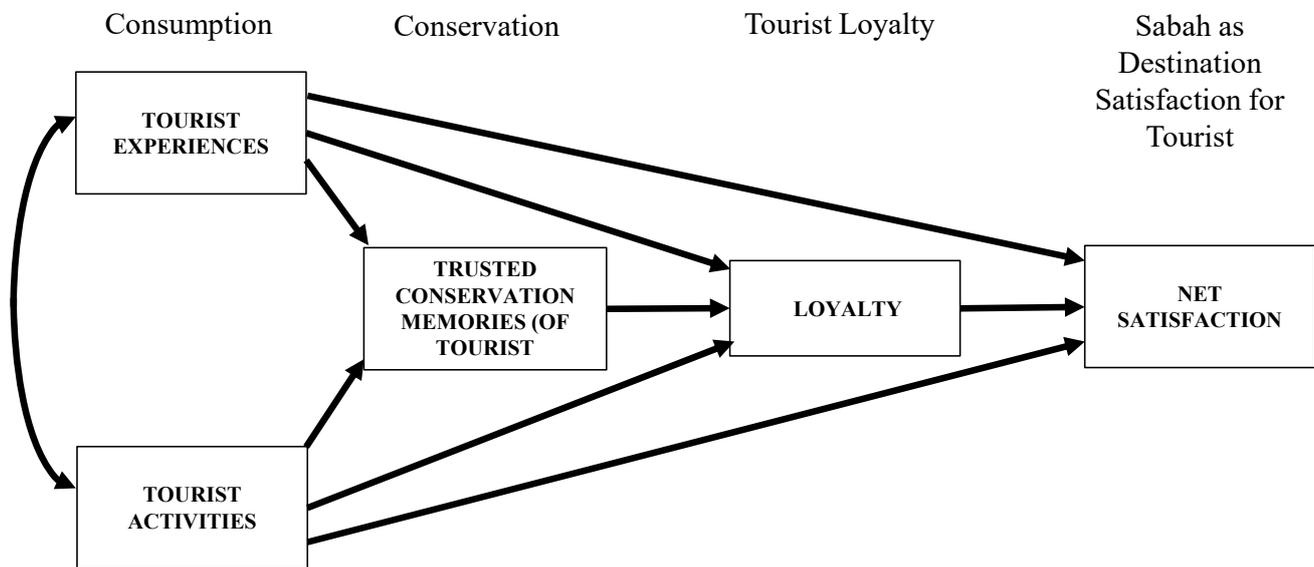


Figure 2: Proposed Tourist Wildlife Behavior Model Framework.

METHODOLOGY

Study Boundaries

The capture of tourist respondents regarding their wilderness/wildlife experiences is limited to visitors undertaking wildlife-based tours of Sabah, Malaysia. Data capture occurs over a five month period and so is time dependent (Blaxter et al., 2002). For cost purposes, this study is conducted at the Kota Kinabalu International Airport (KKIA) (Blaxter et al., 2002). This convenience sample approach depends upon the availability of tourists, access before international flight departures, and the airport’s co-operation (Blaxter et al., 2002; DePoy & Gitlin, 1998). Surveying experience is another practical consideration (Blaxter et al., 2002). Valuable comparative insights towards the selection of methodology, and the above boundary elements, are available in a prior local Sukau Village case study (Fletcher, 2009).

Research Population

A research population can be represented by a well-defined collection of components (Arber, 2001; DePoy & Gitlin, 1998). These are that the tourist (1) has attended and completed a wildlife-based adventure in Sabah, Malaysia, and (2) has likely acquired a degree of satisfaction from this wilderness experience. Four highly-trained, third-year undergraduate students collected KKIA tourist survey responses across various genders, ages and nationalities. The survey was conducted whilst tourists were waiting for their international departure flight. Survey completion took around 10 minutes. A focus group of six, and a small pilot study of 20 Sabah wildlife tourists, helped refine this study's sequential exploratory strategy and items selected (Cresswell, 2003). Departing tourists provided six hundred and forty six (646) valid, self-administered questionnaire data sets (Sarantakos, 1993; Bradburn et al., 2003a; 2003b). The varying levels of literacy, and the language skills among the study participants, remained a limitation to this English only survey method (Davies, 1994), but English remained the most widely used language for those tourists departing KKIA.

Research Coverage

Survey triangulation (Blaxter et al., 2002; DePoy & Gitlin, 1998) involved some 'face-to-face' and voluntary, brief interviews to obtain comprehensive views on some key perceptions provided by the tourist respondents (Hawe et al., 1991; Blaxter et al., 2002). Thus, a more detailed understanding of tourist's wildlife/wilderness experience was achieved (DePoy & Gitlin, 1998).

This study's survey areas include: (1) demographics (asked at the end of the questionnaire) (Bradburn et al., 2003a; 2004b) - and covering: gender, educational qualifications, work status, current country of residence, year of birth (Bradburn et al. (2003a; 2003b), and country of residence; (2) trip characteristics including: times visited Sabah; individual or group travel; how know about Sabah wildlife; travel mode. The Sabah Tourism Board Visitor Survey (STB, 2010) helped develop these questions; (3) behavioral motivations around expectations and activities/attractions (Matlin, 2004) aimed to meet the needs of tourists and to enhance their satisfaction (Graefe et al., 2001); (4) wildlife-based perceptions of experiences, activities/attractions; (5) satisfaction with wildlife-based destination tours (Ragheb & Tate, 1993; Tribe & Snaith, 1998); (6) conservation perspectives as: ecotourism, awareness around the environment, maintaining sustainability, education, and conservation-conscious (Taylor & Baker, 1994; Bolton & Drew, 1991; Tian-Cole & Crompton, 2003); (7) intention to re-visit - important when assessing competitive edge (Parasuraman, 1997); and (8) consumer loyalty as indicative of an overall consumer satisfaction (Petrick, 2002).

DATA ANALYSIS

Demographic analysis

Most tourists who visited Sabah expect to see wildlife. This study shows these visitation reasons include seeing the rainforest (12%), its endemic wildlife (43%), along with its diversity of animals (16%) and seeing an abundance of animals (21%). Another lesser expectation sought is experiencing traditional culture (7%). On average, tourists rated Sabah's wildlife destinations as value-for-money (41%), and as offering a high quality-of-service (46%).

Expectations are generally met during the tourist's stay in Sabah. Here, 39% of tourists perceived they saw more than expected, 34% indicated expectations were met, and 19% noted Sabah exceeded their expectations.

Kinabatangan River (19%) and Danum Valley Conservation Area (17%) are the survey respondents most popular Sabah wildlife destinations – indicating a high wildlife destination imperative by tourists visiting through KKIA. Tourists perceive preservation and conservation (92), scenery (88%), learning (90%), and 'awe-and-wonder' (71%) as key wildlife destination drivers. This indicates conservation should be promoted by Sabah wildlife destinations.

One negative is when tourists' fail to see the wildlife they expect (90%). Other negatives include occasional: inexperience tour guides (66%), bad encounters with insects/leeches (67%), and lack of time at the wildlife destination (79%). Thus, Sabah likely needs to improve its tourist support servicing aspects, and should aim to negate any poor at-destination, in-situ experiences and/or activities.

Most tourists are aged 25-44 years. This age group is most aware of, and most interested in the wildlife species - particularly endangered species - including the orang utans (18%) (n = 113) and the elephants (10%) (n = 66).

Satisfaction with the wildlife destination is broad and complex. It incorporates 13 measurements including: vegetation condition, species diversity, sign-posting, facilities, information centres, staff hospitality, safety measures, species availability, accommodation condition, scenery, road condition, food and convenient business hours. All 13 items hover around a 96% satisfaction level. A single final overall satisfaction question offered the generalized tourism opinion of 'net satisfaction'. This was enlisted in the development of Figure 3.

Quantitative Analysis

Frequencies, average, medians and histograms summarized data and exposed patterns. Pearson's chi square showed significant relations of wildlife viewing types against other variables. Most questionnaire item responses engaged a five point (lowest importance = 1 to highest importance = 5) Likert scale approach. Here non-parametric tests and Mann-Whitney Tests

determined any significant differences against different types of wildlife viewing (Quinn & Keough, 2002). Other questions required factor reduction. This factor reduction approach engaged a varimax orthogonal rotation and a principal components approach to maximize the dispersion of factor item loadings within each construct - whilst assuming all constructs to be independent (Field, 2005). Here, Kaiser-Meyer-Olkin measure of sampling adequacy indicates suitable compactness of the relative correlations (Field, 2005), Cronbach's alpha 0.7 - 0.9) for each construct shows strong internal consistency across the embedded items, and residuals (< 0.05) show compact constructs existed across the Tourist Wildlife Behavior Model (Hair et al. 2010).

Table 2 summarizes the SPSS/AMOS 23.0 path modelling constructs and their final item measures. All measures indicate solid questionnaire response spreads, strong to very strong construct item fits, and solid factor/construct representations (Hair et al. 2010).

Table 2: Construct/loadings for tourists visiting Sabah, Malaysia, wildlife destinations.

CONSTRUCT & MEASUREMENT ITEMS (all items 1=lowest importance, 5=highest)	ITEM LOAD	MEAN	STD DEV	CRONBACH ALPHA	AVE
CONSUMPTIVE EXPERIENCES		3.91	0.83	0.95	0.86
well connected with the (uniques) wildlife	0.930				
adventurous lifestyle (exp) due to wildlife	0.918				
Good tourism facilities and infrastructure	0.908				
CONSUMPTIVE ACTIVITIES		3.83	0.77	0.92	0.75
Nature interpretation	0.930				
Touched wildlife	0.919				
Seeing wildlife in natural environs	0.879				
First time with unique animal in real life	0.720				
TRUSTED CONSERVATION MEMORIES		3.96	0.69	0.73	0.48
Memorable encountered with animals	0.768				
Activities create (environmental) awareness	0.754				
Nature interpretation instills wildlife knowledge	0.544				
LOYALTY (ACQUIRED)		3.87	0.78	0.95	0.83
Will definitely come again	0.934				
Suggest to families and relatives	0.911				
Promote in website/blog/media social	0.905				
Attached as volunteers	0.887				
NET(ACQUIRED) SATISFACTION (1 item)		3.72	0.78		

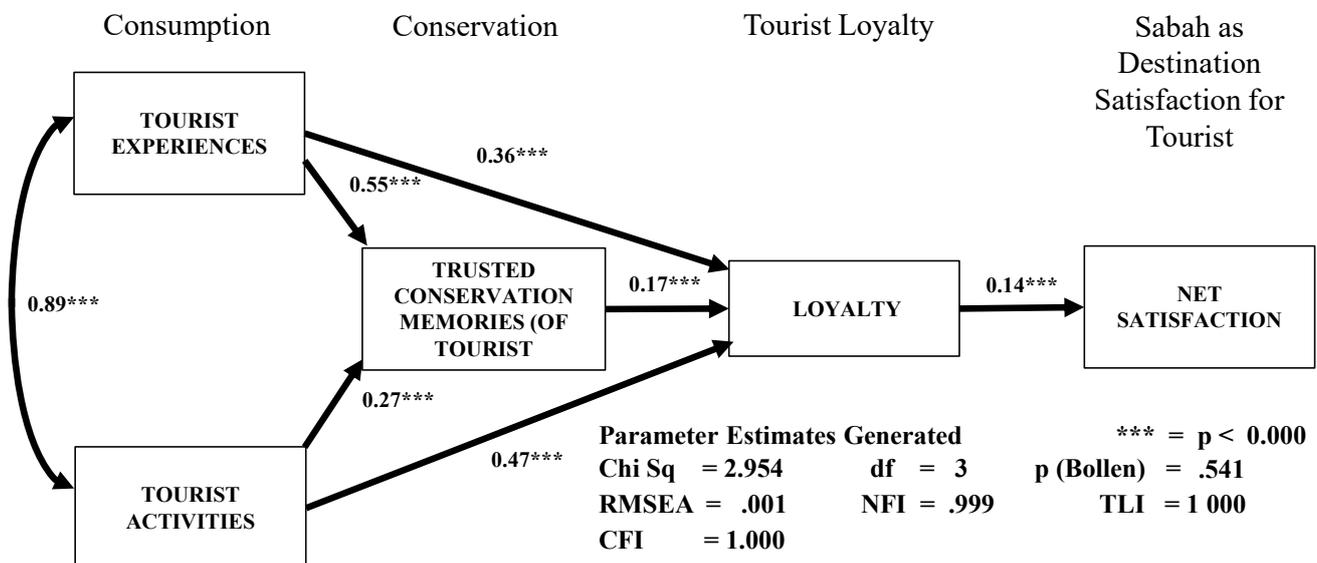


Figure 3: Tourism Wildlife Behavior Path Model.

The Figure 3 AMOS 23.0 path model developed from Table 2 for the 646 tourist cases delivers an excellent fit model ($\chi^2/df = 1.0$, $p(\text{Bollen-stine}) > 0.541$, $RMSEA = 0.001$, $NFI = 0.999$, $TLI = 1.000$, $CFI = 1.000$), with all pathways very highly significant (<0.001). No further paths can be removed, and no alternative models can be generated. The tourist's overall net satisfaction measure is included as a single item as it represents an important Sabah wildlife tourism driver. If this net satisfaction construct is removed, an excellent fit saturated model still exists – again supporting the validity of the Figure 3 path model structure.

DISCUSSION

With the two highly correlated independent constructs and the single item net satisfaction measure each being further developed, Figure 3 model path improvements may be exposed. For example the construct 'trusted conservation emotions' is currently not delivering significant paths in the Figure 3 path model, yet is should work conjointly beside the trusted conservation memories construct, and so deliver a stronger Figure 3 stage 2 conservation memories intermediaries block. Revisiting, and improving these constructs may be a useful model redevelopment in the future.

Figure 3's standardized total effects (Table 3) of the tourist's perceptions of their consumptive wildlife event experience and activities shows their perceived net effects onto each downstream construct. These downstream constructs (tourist's trusted conservation memories, tourist's loyalty, and tourist's overall satisfaction with the wildlife destination event) show the wildlife destination event strongly influences the tourist's conservation memories as well their loyalty, and these reflective measures then exert a small contribution towards the tourist's overall net satisfaction (Table 3: 7.4% and 6.4% respectively) towards this reflective wildlife destination tourist perception in Sabah, Malaysia. The paths between experience and activities to net-satisfaction are not significant, and so are not presented in the Figure 3 tourism wildlife behavior path model.

Wildlife destination consumptive experiences and activities both strongly influence tourist loyalty (Table 3). Hence, Sabah's wildlife tourism destinations should focus on presenting tourists with unique and educative information that is focused on instilling behavioral and lasting memories of the wildlife destination. This approach may encourage revisits by loyal tourists. These destinations should also focus on offering additional event, historical, sustainable, and/or environmentally-sensitive options that display a likely appeal to the tourist. This helps create an ongoing sense of deepened tourist loyalty towards Sabah and towards its sustainable wildlife destination environments and habitats.

Table 3: Standardized Total Effects of Constructs onto Dependent Construct (Acquired Satisfaction) for those visiting Sabah, Malaysia (all respondents).

CONSTRUCTS (FIGURE 2)	WILDLIFE DESTINATION CONSUMPTIVE EXPERIENCES	WILDLIFE DESTINATION CONSUMPTIVE ACTIVITIES	TRUSTED CONSERVATION MEMORIES	LOYALTY
TRUSTED CONSERVATION MEMORIES	0.27	0.55		
LOYALTY	0.52	0.45	0.17	
NET(ACQUIRED) OVERALL SATISFACTION	0.07	0.06	0.02	0.14

As the tourist's reflective overall satisfaction decision only loosely relates to their wildlife experiences and activities (Table 3), other supporting factors obviously interplay. These factors lay beyond the scope of this study. They include such factors as: transport, time, food, accommodation, climate, other external conditions, costs, services, and language support.

IMPLICATIONS OF RESEARCH

Theoretical Implications

This empirical research supports the tourism wildlife behavior path model and also delivers a Bollen-Stine bootstrap validation of the model. It shows that for wildlife tourists, statistically-significant, net-one-directional learning paths do exist, and that all fields of the model are significantly inter-related. This research also confirms that the wildlife tourist primary independent motivational drivers (experiences and activities) for wildlife interaction do reside within the Sabah wildlife destination arena.

This research may be repeated across different nations of the globe - with wildlife tourism preferences towards unique and endemic viewing preferences being predicted as motivators. Using AMOS 25.0 path model approaches, in conjunction with specifically-linked surveys, and with additional outcome constructs flowing across conservation domains, loyalty, and satisfaction as business style outcomes are projected as model drivers.

Further in-depth assessment is possible through survey developments/enhancements to the items currently deployed, and to subsequent SEM approaches that target strong, unidimensional model development options - ones that further segment the model against demographic categories. For example, this research indicates a difference exists between first-time Sabah wildlife tourists, and Sabah revisiting tourists. Hence, sectioned studies may provide further model enlightenment for those managing wildlife tourism operations in Sabah.

This research has the potential to improve Sabah's, and other wildlife destinations', understanding. Here, moves towards focused wildlife tourism studies is projected to be of value to those managing or marketing such environmentally-sensitive destinations. Thus, a more costly, deeper experiential, and activities-based solution may offer further tourist stimulation. Considerations towards further model changes may present further interesting areas of related research – especially where engaged in other national arenas.

Within wildlife tourism areas, and across nations of the globe, there is an imperative to investigate the net-benefits of such wildlife tourism destinations as an alternative to, or a complement to, generating further understanding around the total tourist-provided package of connected and location-specific activities.

Practical Implications

Wildlife tourism operations and/or their marketers) in Sabah, may utilize this study's information, and their own observations, to better design their program experiences and task activities. This study's survey approach elucidates aspects of wildlife tourism believed of most value, and these areas can then frame into future management or marketing packages. Such approaches can result in engaging mixes of tourist learning activities being offered within a specific wildlife destination, and these new approaches can also drive additional knowledge into the wider global tourism market.

Tourism operators and their marketers can use this research approach to help build destination policies related to tourist quality-learning and their how such outcomes may be delivered within their controlled delivery systems. Additional wildlife destination studies tackled by other researchers may capture new construct items along with new sets of refocused outcomes - that may even extend through to governmental policies and area controls.

Wildlife tourism in the natural habitat setting of the endemic species likely differs in its processes to guided tours or zoo-based tours. In at-destination, natural wildlife settings, net learning outcomes are likely higher, and a closeness sensitivity may emerge. This likely brings a degree of tourist-assessed opinion that should be regularly tapped to further support destination and governmental policies, and to expand the tourist's learning options. Policy could then refine to build (1) more engaging wildlife tourism options, and (2) further virtual and tangible experiential wildlife tourism options, and (3) additional activities that build an homeostatic (or ongoing and aligned) connection between the tourist and the endemic wildlife species. Such learning engagement processes likely enhance the tourist's perception of the overall wildlife tourism event.

FUTURE RESEARCH

Measurement Aspects

This study, and its links from previous studies, offers a basic set of literature-based empirical measures that can be developed, and/or extended and/or modified to enhance and expand the knowledge pathways generated within the wildlife tourism field. This path model approach extends relationships between different constructs, and establishes flow paths which may be used by others when setting new and broader strategic wildlife tourism measures and directions. This moves existing research beyond previous studies.

Tourists learn and acquire knowledge differently - especially when exposed to different wildlife environments. Learning and knowledge acquisition is likely age and number of visits related. This may bring a tourist behavioral change that is likely linked to the destination offerings, and/or to their tourist involvement processes. This area offers exciting scope for many future wildlife tourism measurement studies, and for possible associated virtual wildlife tourism application studies.

Theoretical Aspects

At the tourist operations level researchers may consider how to operationalize their uniqueness capacities, and may then consider how these competencies may be better-packaged, developed, and deployed as quickly as possible – possibly incorporating a raft of discovered educative, knowledge transfer, experiential, and activities processes.

This study indicates an overall tourist interactive reeducation process could be offered. This is a behavioral deliverance process. Hence, behavior should be considered for incorporation into across wildlife tourism processes. This then offers further theoretical approaches - possibly based around the Theory of Planned Behavior and Users-Gratification Theory.

Management Aspects

Wildlife tourism researchers may refine our literature supported approach and add, remove or refocus this study's Table 3 measurement items into a more detailed 4 stage Tourism Wildlife Behavior SEM constructs model. This approach likely generates further understanding around the continuum of wildlife tourism connection options that operate within the differing

nations of the globe. It also offers contrasts between nations. Incorporation of mobile technologies into these domains may also open still further new measurements and social media approaches.

CONCLUSION

The research question ‘do Sabah’s consumptive wildlife-based (experiences and activities) adventures evoke measureable, overall satisfaction changes for the tourist?’ is behaviorally answered via the Tourism Wildlife Behavior Path Model. This tourist behavioral perceptions model shows the Sabah wildlife destination experiences and the in-situ activities offered can evoke a strong tourist loyalty, but they only evoke a small joint positive effect on the tourist’s reflective overall satisfaction. This small satisfaction effect is likely due to the many competing satisfaction influences following the above demographic analysis section. Hence in future studies a range of satisfaction measurement items should be included. This can likely deliver an improved Figure 3 model.

In this study, the proposed tourist wildlife behavior model path model framework is partially supported but the two paths proposed between tourist experiences and net satisfaction, and tourist activities and net satisfaction are both found not to be significant at $p < 0.05$. The construct ‘trusted conservation emotions’ is currently not delivering significant paths in the Figure 3 path model. Again, this study’s work may work if the independent constructs, and/or the net satisfaction construct item, are each improved by including further relevant measurement items into one or all of these three constructs.

Today, the tourism industry, at destinations in Sabah Malaysia, is seeking an all-round comprehensive approach that is not only comprehensible, but also one that delivers interpretable (and cost effective) results, and one that focuses towards the future. The Tourism Wildlife Behavior Path Model now provides a framework for the destination tourism industry in Sabah to identify its strengths and/or weaknesses, and to then seek improvement solutions for the experiences and the activities on offer.

Used positively the Tourism Wildlife Behavior Path Model can help frame a more polished servicing, an improved educative perspective within a physical wildlife destination, and a greater tourism loyalty may result. Hence, wildlife tourism parks and their personnel should try to generate both lasting and informative tourist memories. For example, improved connecting infrastructures, better servicing connections, and visit observations well-timed around active wildlife behaviors (like feeding, movement or group connective actions) do add value to activities and experiences and then likely raise the satisfaction levels of outbound wildlife tourists.

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A Conceptual Framework for Data Property Protection Based on Blockchain

(Work in Progress)

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ABSTRACT

Blockchain is a new decentralized infrastructure and distributed computing paradigm. The blockchain technology has the characteristics of decentralization, time series data, collective maintenance, programmable and secure. This paper addresses the needs of China Mobile's digital intellectual property protection and transaction, and uses the relevant design and technology in the blockchain to propose solutions and ideas for identity authentication and traceability of China Mobile's digital intellectual property transactions. Finally, the design concept of blockchain architecture based on China Mobile digital intellectual property transaction is proposed.

Keywords: Blockchain; Digital asset; Traceability; Smart contract

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INTRODUCTION

At present, with the emergence of new technologies such as artificial intelligence, blockchain, Internet of things and 5G, the global digital transformation has entered an accelerated period, and human society has gradually entered the era of big data. As an important product of the rapid development of information technology and mobile Internet, big data is beginning a major era transformation. Among them, as the amount of data continues to increase and the field of application becomes more widespread, the value of data is increasing day by day. And more and more industries and fields are committed to pursuing the potential value behind the data. This makes the data transaction demand more and more urgent, and also makes the protection, application and management of data property rights face severe challenges.

As a value-adding tool, big data technology will bring unprecedented data changes, and deeper commercial potential and value can be discovered through data. Big data can help managers to make intelligent and reasonable decisions and improve the efficiency and level of enterprise management. Therefore, both the data demand side and the supply side have strong data transaction willingness, and the formation of the data transaction market is beyond doubt. However, due to the current perfect data trading market has not yet formed, data transactions lack legal channels. Data transactions face legal risks such as unclear property rights, complex authorization, difficult pricing, lack of transparency in transactions, difficulty in ensuring fair transactions, and leakage of privacy(Lafuente,2015).Therefore, a careful analysis of the current data transaction status and data transaction characteristics, clarifying a series of issues related to property rights protection in data transactions, is essential for deepening the innovative application of big data in various industries(Yuan &Wang,2016).

With the development of Internet technology, in order to realize the transformation of information Internet to value the Internet, blockchain technology emerged as the times require. Blockchain technology is a new type of decentralized infrastructure and distributed computing paradigm with distributed storage, time-series data and non-tamperable, decentralized credit, smart contracts, high privacy protection, etc(Sun,2016).These make the blockchain technology provide a solution to the problems of high cost, high security and high risk that are common to traditional centralized technologies. Because of the above characteristics of blockchain technology, considering the use of blockchain technology in the data transaction process can help to better trace the source in the data transaction process, locate the data value chain, confirm the data ownership, etc. Solve the security risks in the data transaction process under the era of big data.

LITERATURE REVIEW

Intellectual property rights is an intangible property right that people enjoy in accordance with the results of their intellectual activities and the marks and credits in their business management activities(Wang &Gu,2009). The growth effect of intellectual property protection depends on the gap between China's technology level and the world's technological frontier(Li,2016).Intellectual property protection is further divided into property rights protection of physical assets and data assets.

Nowadays, watermarking technology, digital copyright protection technology, and related legal such as “The Agreement on Trade-Related Aspects of Intellectual Property Rights” and “The Measures for the Administrative Protection of Internet Copyrights protect intellectual property rights”.etc are available.

Data transactions mainly refer to the process of transferring big data as a resource and transferring it to the demander through various trading methods(He,2018).Big data has become a new strategic highland in a major of industries in China, but its power ownership and system security still plague the development of these industries and industries. At present, the main factors restricting Big Data's role in China are as follows: (1) data standards and sharing issues; (2) data privacy issues; (3) intellectual property framework and protection innovation; (4) technical standards and research and development in key areas(Han *et al.*,2018) Traditional digital asset transactions require transactions through a third-party trading center during the transaction because of mistrust between users. The user uploads the data to the transaction center, and the transaction center grasps all the data information, and the user's inquiry and transfer of the assets are completed by the transaction center(Ding, 2015).Because the trading center is a centralized system, once hacked, all data will result in lost and irreparable results. In traditional digital asset trading, saving data can only be encrypted by simple data. There is no signature verification mechanism in the transaction transmission process to ensure the security of the data transmission process. The traditional digital asset trading system is a seemingly “trustworthy” central management organization to manage the transaction process. The intermediate link will inevitably lead to managerial negligence and infringement of data property rights. Whether the user's interests are damaged depends mainly on the integrity of the transaction center management degree (Zhang *et al.*,2016).

In view of the above drawbacks of traditional data transactions, data property rights can not be well protected, so this paper proposes a method of data property protection based on blockchain technology. The blockchain technology involves time-stamping, Merkle tree, consensus algorithm, and other technologies to realize the authenticity and traceability of data transactions.

Timestamp: The blockchain technique requires that the node that obtains the accounting rights must be time stamped in the current data block header to indicate the write time of the block data. The timestamp adds time dimension to the future blockchain-based Internet and big data property protection. For suspicious data transactions, auditors can use the blockchain timestamp to trace the source and verify the data to accurately analyze whether the data is Tampering; it also increases the spatial dimension and eliminates the risk caused by information asymmetry. Therefore, the auditor who obtains the authorization key can access the audit data without space restrictions, greatly improving the scope of audit supervision and preventing infringement.

Merkle Tree: The Merkle tree is an important data structure for blockchains. Its role is to quickly summarize and verify the existence and integrity of block data. The hash algorithm is combined with MerkleTree to implement the data storage function of the blockchain, and the information stored in the block is transaction information. This is the main function of the MerkleTree tree. At the same time, the Merkle Tree structure feature can support hash data comparison in a short time; only verifying the root of the Merkle Tree can verify the validity of the data, thus protecting the privacy of the transaction data^[1].

The application of blockchains in the field of asset management has broad prospects for enabling the identification, authorization and real-time monitoring of physical and digital assets. For physical assets, by combining IoT technology to uniquely identify and deploy assets to the blockchain, it can form “digital intelligent assets” to realize distributed asset authorization and control based on blockchain; For digital assets, based on the characteristics of time stamp technology and non-tampering, blockchain technology can be applied to intellectual property protection, domain name management, and point management.

IDENTITY AUTHENTICATION DESIGN AND TRACEABILITY PROBLEM

China Mobile's digital intellectual property transactions and protection are mainly studied through blockchain identity authentication and blockchain data anomaly traceability. The following are two parts of the design concept and related research perspectives.

China Mobile Digital Property Rights Identity Authentication Design

The characteristics of China Mobile's digital property rights transaction require that the type of blockchain is different from the public chain type of Bitcoin. The behavior of nodes joining and exiting the blockchain is not free, but is subject to supervision by China Mobile. Based on the above factors, the blockchain type of China Mobile Digital Property Rights Transaction should be selected as the alliance chain.

For the alliance chain, refer to the structural design of the hyperledger to discuss the design of the identity authentication problem in the context of China Mobile Digital Property Rights Trading.

In the hyperledger, the concept of PKI was introduced. What is a PKI? A public key infrastructure (PKI) is a collection of internet technologies that provides secure communications in a network.

Digital certificate

In the hyperledger, the digital certificate is a module for storing user information, which is similar to the citizen's identity document, in which the public key information is stored in the digital certificate, and at the same time, the digital certificate is designed based on cryptography to ensure the content of the digital certificate. Information is not tampered with. China Mobile's digital property rights transaction requires that each node in the China Mobile blockchain network has a unique digital certificate for storing information about the node. At the same time, any node that wants to join the China Mobile blockchain network must hold a digital certificate.

Public and private keys

Authentication and message integrity are important concepts in secure communication. Authentication requires that the parties who exchange messages create the identity of a particular message.

Traditional authentication mechanisms rely on digital signatures, which, as the name implies, allow a party to digitally sign their messages. Digital signatures also guarantee the integrity of signed messages. Technically, the digital signature mechanism requires each party to hold two keys for an encrypted connection: a widely available public key and a private key that acts as an authentication anchor, and a private key that is used to generate a digital signature on the message. The recipient of the digitally signed message can verify the source and integrity of the received message by checking if the additional signature is valid under the intended sender's public key.

Under the China Mobile Digital Trading Framework, due to the characteristics of China Mobile's digital transactions with other different companies, this requires the confidentiality of trading information. Referring to the design of the hyperledger, the transaction is encrypted and decrypted by the public key private key to ensure the security of the transaction.

Certification authority

In the hyperledger, the node participates in the blockchain network to have a digital certificate issued by the system trust authority. This system trust organization is called a certificate authority (CA). China Mobile's digital property rights transaction, the certificate issuance work to be completed by China Mobile, the company that cooperates with China Mobile, the transaction company to apply for the digital certificate of the blockchain network to China Mobile. By referring to the design of the identity information content of the hyperledger, China Mobile can solve the identity authentication problem in the digital transaction process, that is, the authorization problem. The specific blockchain transaction process design also needs to be designed according to the characteristics of China Mobile Digital Property Rights Transaction.

Certificate revocation list

A certificate revocation list (CRL) is easy to understand, it is just a list of references to certificates that the CA knows to be revoked for some reason. China Mobile has the right to issue digital certificates in accordance with the relevant applications and also has the right to revoke digital certificates in accordance with the relevant rules. This requires design based on specific circumstances.

Research Concept Based On Blockchain Traceability

Each transaction generated in the blockchain will complete the transaction storage through the consensus mechanism of the blockchain. At the same time, each transaction guarantees the queryable traceability. The new hypothesis of the blockchain traceability problem is proposed below.

Merkletrees is an important part of the blockchain structure. Each block has a Merkle tree starting from the leaf node (bottom of the tree) and a leaf node is a transaction hash (bitcoin uses double SHA256 hash). The advantage of the Merkle tree is that a node can verify that a transaction is included without downloading the entire block. And these only need one transaction hash, one Merkle root hash and one Merkle path.

Based on the merkle trees, it is proposed here whether the problem of blockchain traceability can be based on the characteristics of the merkle trees.

The data of the blockchain is stored in the leaf nodes of the merkle trees, and then the hash operation is continuously performed by the leaf nodes, and finally the root of the tree represented by the hash value is obtained. A change in the value of a leaf node causes

a change in the final root hash value. Based on this feature, the idea of traceability of blockchain anomaly points based on merkle trees is proposed.

BLOCKCHAIN ARCHITECTURE DESIGN MODEL BASED ON CHINA MOBILE

The blockchain model proposed in this paper is designed for the actual business of China Mobile, and it mainly realizes the functions of data security and data source tracking in the process of data asset transfer of mobile companies. In this framework, the service requester and the service provider establish a trust relationship through the blockchain, and use the smart contract to generate and manage new transactions, and broadcast the transaction information to the entire network, and the node receiving the information passes. The consensus mechanism verifies the transaction and protects against malicious attacks, and the verified transaction is written into the blockchain.

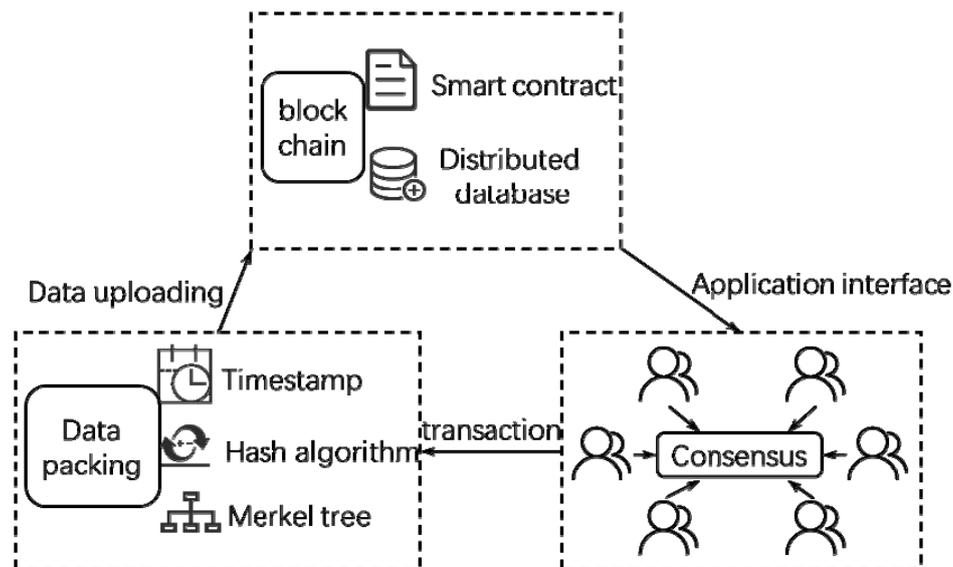


Fig. 1 A blockchain-based digital asset management framework.

In the framework, China Mobile internally forms a Private blockchain of mobile companies by the provincial branch offices according to business needs, and the external business forms Consortium blockchains with other companies. China Mobile Headquarters acts as an intermediary to connect the Private blockchain and the Consortium blockchain. In the given blockchain, according to a set of rules, a legitimate transaction defines how to change the state, and what meaning can be obtained from that state. Therefore, transactions are treated as applications of business logic in the blockchain, so complex applications are often referred to as smart contracts. First, the external company sends a data access request through the API, and then calls the smart contract in the blockchain to extract the relevant data. Finally the external node gets the required data.

At present, the digital asset trading market has problems such as lack of transparency, cumbersome procedures, fraud risks, and public record errors during the transaction period and post-trade process. The application of blockchain technology enables the recording and tracking of digital asset ownership, usage rights, usage records, etc., and ensures the accuracy and verifiability of relevant documents.

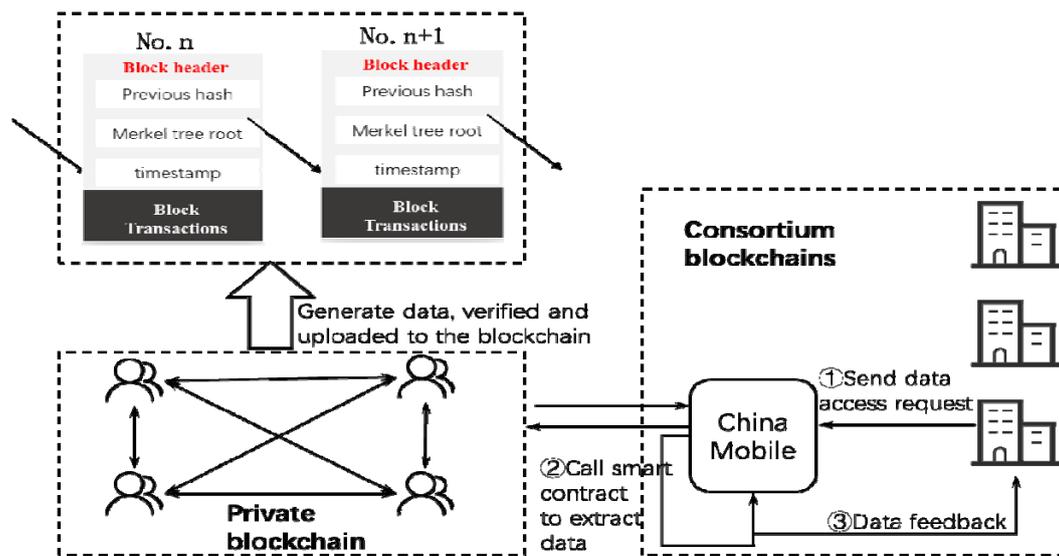


Fig. 2 Blockchain framework of China Mobile Network

In addition, block-chain technology enables real-time paperless and real-time trading. The use of blockchains and smart contracts to verify, bill, store, maintain, and transfer transaction data between service providers and service requesters. As shown in the figure, the blockchain technology is used to realize highly transparent information, non-tamperable information, and high anonymity in the mobile service networking, so that it can manage record transactions and reduce management costs with little or no personnel involvement.

CONCLUSIONS

The blockchain-based China Mobile digital asset management framework proposed in this paper solves the problems of opaque and vulnerable to digital asset transaction transactions by using blockchain, smart contract and consensus mechanism, and realizes decentralization, transaction transparency and security. Traceable service management effectively reduces management costs, improves overall system operation efficiency, and reduces malicious attacks and spoofing.

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A Hybrid Travel Recommender System for Group Tourists

(Work in Progress)

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ABSTRACT

Travel recommender systems (TRSs) are developed as information filtering tools to provide travel decision-making support. They make personalised recommendations based on the user's preferences. People tend to make group travel decisions based on trip-specific motivations. The current Group Travel Recommender Systems (GTRSs) exploit individual user's preferences and make group recommendations by aggregating profiles or aggregating recommendations. Although aggregation is a straightforward way to combine the preferences of different group members, it has been critiqued on overlooking of the group dynamics. Interaction needs among tourists' have a great influence on group travel preference. This proposed study explores a conceptual framework for a hybrid group travel recommender system based on this consideration.

Keywords: Smart Tourism, Group Travel Recommender System, Group Travel Motivation, Group Interaction Needs

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INTRODUCTION

Travel Recommender Systems (TRSs) are technical ways to filter travel information and support tourist decision-making process. They provide personalised travel recommendations to users by studying users' past preferences, and further predict their future travel preferences through analysing their travel behaviour patterns and travel interests (Logesh, Subramaniaswamy, Vijayakumar, & Li, 2019). TRSs are the responses to the facts that tourists don't have a broad knowledge of all travel information, and excessive amount of travel information is challenging for humans to cognitively deal with (Garcia, Sebastia, & Onaindia, 2011). In addition, Information Communication Technologies (ICTs) not only make it easier to present more tourism products online directly to tourists but also enable tourists to take active role in choosing their own preferred tourism products, instead of accepting standard services. Tourists today are more experienced and demand more diversity on their trips (Garcia et al., 2011). Every tourist has different travel motivations (e.g. relaxation, experience novelty) (Crompton (1979) , individual interests (e.g. sports, art), constraints (e.g. budget, time) (Crawford, Jackson & Godbey, 1991). Tourists travel with different travel motivations each time. This leads to different travel considerations and preferences. The choice of the destination is most influenced by the travel party and his or her constraints on the destinations(Crawford, Jackson & Godbey, 1991). The interaction between/among group tourists affect the group travel preferences (Bagozzi, 2000).

In consequence, Group Travel Recommender Systems (GTRSs) emerge and are designed to fulfil the needs of supporting multi-users group travel decision-making process. Recommending for all travel parties can be difficult as each member can have different preferences. Firstly, GTRSs will acquire individual travel preferences explicitly and implicitly which have no difference with the individual user travel recommender systems (Jameson & Smyth, 2007). Secondly, based on the assumption that individual preferences are independent choice sets, Masthoff (2015) indicates that two different group recommendation techniques, recommendation aggregation and profile aggregation, can be used to generate group recommendations. Recommendation aggregation is to examine each group member's personalised recommendation and merge the results of individual recommendations and generate a single final recommendation list match for the group users. Profile aggregation creates a joint group profile of preference profile and demographic profile (Logesh et al., 2019). With the integrated individual user's likes and dislikes in preference profile and demographic constraints such as gender and age in demographic profile, GTRSs adopt group aggregation techniques such as Plural Voting and Most Pleasure. However, recent researches have argued that the aggregation method assumed the simple combination of individual preferences, and they propose an observational group recommendation approach. This approach emphasises that group preferences are constructed in decision-making process by using critiquing and case-based reasoning(Nguyen & Ricci, 2017). However, this approach requires a large database to store group conversational chats, and it takes time for the system to learn and build up the interaction model for the group members by observing the group discussions.

In spite that there are emerging GTRSs have considered the group dynamics by observing their group conversations, the attributes of group members' needs for interaction and group travel motivations have not been thoroughly investigated. Group travel motivation as a key variable for group travel has been researched in the packaged tour context. It helps understand certain groups of people's needs (e.g., senior tourists) and enhance the service providers' knowledge on providing suitable services. (Chang, 2007). But in the context of the highly personalised self-organised group travel, the group travel motivations are defined as a dynamic concept which change time to time, vary with different travel parties. Extent articles have examined on traveling with family (Wang, Yi, Wu, Pearce, & Huang, 2018), lovers (Kim & Agrusa, 2005) and friends (Song, Wang & Sparks, 2018), these articles have supported the interaction needs for travel parties with certain social relations, for example,

family-oriented group travel motivation aims at not only on children's or elder parent's needs, but also focusing on experiencing activities that can be explored together where we-memory can be created. Honeymoon travel motivation as a strong evidence of the interaction needs for travel parties, instead of individual oriented needs. For example, the wife likes art and music, and the husband likes football, but they are destination choice is not only seeking for the overlaps or consensuses of their interests, but also considering their interaction needs and enhancing the newly established marital relationship purpose. (e.g., romantic and interactive activities). To date, there is no widely agreed group travel motivation framework to explain what the group travel motivations are, how they affect group members' interaction and how do they impose on the travel destination and attraction choices.

The group travel motivation in different contexts, and how to meet their interaction needs in designing GTRSs has not been investigated yet. The interaction needs and group travel motivation have been overlooked in both group travel theories and the existing group travel recommender systems. This paper intends to develop a conceptual framework to examine how the group travel motivations would affect the group tourists' travel preferences on destination and attraction choices, and specifically under three major social relationships (i.e. families, lovers, friends) by using datamining technique on analysing tourist reviews. It also intends to find co-relations between these motivations and the type of attractions. Finally, it proposes a conceptual framework for GTRS to design a group recommender system considering group travel motivations.

LITERATURE REVIEW

Influential Factors on Travel Preferences

In literature, three groups of influential factors on individual travel preferences have been investigated. Firstly, the individual tourist related factors, the decision maker-specific factors such as age, income and travel constraints (Crawford, Jackson & Godbey, 1991), have found strong influence on individual travel preferences. Psychological variables such as personality and travel motivation have direct effect on tourists' type, for example, Gretzel, Mitsche, Hwang, and Fesenmaier (2004) integrated travel needs/motivations, travel styles, desired activities, desired destination features, personal value into 12 travel personalities. Neidhardt and Werthner (2017) propose a Seven-Factor Model by considering tourists role in the group, travel motivation and tourist travel personality, categorised group tourists into 7 types. Travel motivation is very trip-specific (Qiu, Masiero, & Li, 2018). Travel Motivation can be seen as push factors are internal forces that drive a tourist towards an action, such as human needs (e.g. relaxation, social belongingness, exploration and evaluation of self, prestige, enrichment of relationships and enabling of social interaction) (Dann, 1977). Crompton (1979) states seven social-psychological motives including escape from a perceived mundane environment, exploration and evaluation of self, relaxation, prestige, regression, enhancement of kinship relationships, and facilitation of social interaction. Besides seeking for satisfaction from social-psychological factors, tourists are also motivated by cultural motives. Tourists' culture of origins explained by socio-political differences, geographical distances, cultural values or lengths of statutory holidays (Becken & Gnoth, 2004) influence tourists' travel style preference. Most of the individual tourists related factors have been considered in the existing travel recommender systems in terms of user profiling process.

Secondly the destination-related factors have been viewed as the determinants of destination choices where two categories can be included (Laws, 1995). The primary category is related to innate features (e.g., climate, seasons, natural resources, historical architecture). The secondary category is the "given" and partly "man-made" (e.g., facilities for certain sports, shopping malls). These factors have been considered in some context-aware travel recommender systems such as crowdedness-aware, temporal aware (Sassi, Mellouli, & Yahia, 2017). There are limited articles have investigated the determining attributes to certain groups. For example for honeymoon tourists, they are not only looking for places with good scenery, good weather, historical and cultural resources, but also specifically seeking for romantic places (Kim & Agrusa, 2005).

Thirdly, the travel party related factors significantly group travel preferences. The travel party related factor can be seen as interpersonal barriers (Crawford, Jackson & Godbey, 1991). According to Crawford et al, interpersonal barriers will lead to non-participation if the specific activity wouldn't meet the interaction needs or require more than one partner interaction. The relationship between individuals' characteristics, interpersonal barriers affect the joint preference for specific leisure activities or arise as the result of spousal interaction. This concept is also applicable to interpersonal relations in general such as family-child, friend relations. In GTRSs, the barriers for joint preference for some activities have been considered by creating joint group demographic profiles. However, the GTRSs have seldom considered the interaction needs among the groups.

Group Travel Interaction & Motivation

Group travel is different from the individual travel in terms of tourists' decision-choice process and associated contextual factors such as travel parties and travel motivations (Regan, Carlson & Rosenberger III, 2012). The needs for facilitation of social interaction, enhancement of human relations and group affiliation, have been emphasised in group travel (Regan et al., 2012). Group interaction can be built on the believe that "key basis for group action... is the mutual possession of a sense of 'us'" (Bagozzi, 2000). Yarnal and Kerstetter (2005) further identify that group behaviours are governed by feelings about the situation from the individuals', their interactions among each other and the personal factors that bring to the situations. Therefore, group travel preference should never be a simple combination of individual's preference (i.e., $1+1 \neq 2$). Current literature has focused on group composition analysis, group travel motivation exploration (e.g., group travel to major events), group behaviour modelling (e.g., senior tourists). Yet, there is little research focusing on examining group travel motivation and group travel behaviour pattern in a large and more general scale. This research explores tourists' interaction needs and

group travel motivations by mining travel reviews from open travel platform and analysing the hidden patterns and sentiments. It further reinforces the needs of considering the interaction needs and group travel motivation difference in group recommender system design.

Travel Recommender System

Travel recommender systems are designed to provide personalized travel recommendation based on user's preferences and interests. By studying the users' preferences, there are difference recommendation techniques have been developed over the years. Demographic-based filtering technique (Pazzani, 1999) is used to recommends items to users from similar demographics such as tourist's age, gender, education. Knowledge-based filtering technique further develops that (Pazzani, 1999) the knowledge-based recommender systems generate a recommendation by reasoning about what items meet the user's requirements and constraints. Content-based filtering (Pazzani, 1999) recommendation is made based on the tourists' profiles using features extracted from past histories. The items which will be recommended are those mostly related to the previous positively rated items. Content-based filtering would suggest destinations with the tourist's like the most but lack of diversity (Ricci, Rokach, & Shapira, 2011). Collaborative filtering target tourists are recommended destinations and attractions similar to those chosen by other tourists with similar travel preferences however it may suffer from the cold-start problem, which means a new tourist user, or a new destination needs to be rated before a recommendation can be made (Ricci, Rokach, & Shapira, 2011). There are also two approaches, memory-based and model-based filtering. In memory-based approach, tourist user's historical records to other records in the database is compared. The memory-based approach compares a user's historical records to other records in the database (Ricci, Rokach, & Shapira, 2011). The model-based approach uses statistical or learning methods, such as Bayesian network (Logesh & Subramaniyaswamy, 2019). Cold start and data-sparsity problem are the two drawbacks of this technique. The cold-start problem occurs when the system does not have enough information regarding the destination/attraction or tourist to make a prediction. Tourist user needs to provide a significant amount of information before the system can generate a destination/attraction recommendation. Therefore, hybrid recommender systems use a combination of the abovementioned methods, exploiting the advantages of one technique to compensate the shortcomings of another, thereby improving the overall performance (Logesh & Subramaniyaswamy, 2019).

Group travel recommender systems have two major approaches, one is social choice theory based recommendation (Masthoff, 2015) and the other one is group dynamics and group decision-making theories based recommendation. Social Choice Theory (Arrow, Sen, & Suzumura, 2010), as the supporting theory of GTRSs, explained the aggregation which aggregated multiple factors so as to discriminate between multiple alternatives. Based on this theory, Masthoff (2015) suggests that GTRSs adopt group aggregation techniques including three major categories 1) majority-based strategies which use the most popular items (e.g., Plural Voting: most liked items); 2) consensus-based strategies that consider the preferences of all group members (e.g., Average: averages individual ratings); and 3) borderline strategies that only consider a subset (e.g., Most Pleasure: takes the maximum of individual ratings) to make a combined group recommendation. Additionally, aggregation strategies have been modified by giving different weight to different users considering their constraints and influence among the group (Berkovsky, Freyne, & Coombe, 2009). For instance, higher weight is given to children or people with disabilities because of their limited physical status, people who are experts or have higher social impacts as they probably will influence the whole group decision. This weight aggregation technique in a way has taken the group composition and group roles into consideration.

From the aggregation approach, most of the studies have been focused on POIs recommendation by focusing on how "fair" it will be by aggregating individual group user's preference into group preference while adopting different techniques; and also focus on how to improve the personalisation level of extracting individual user profile. Hybrid approach with a combination of content-based filtering, collaborative filtering and knowledge based filtering has been used to aggregate individual recommendation list into group list (Pessemier, Dhondt, & Martens, 2017). Social pertinent trust walker algorithm and social network collaborative filtering has also been used to better create the group profile (Ravi & Vairavasundaram, 2016).

However, researches have shown that an absolute best aggregation strategy does not exist. Moreover, most of the GTRSs completely neglected the specific aspects of a group such as group related dynamics, group composition, concentrate on solely on individual preferences of group members. Based on these considerations, group dynamic based GTRSs have been developed. Group dynamics and group decision-making theories-based recommender systems do consider more the joint decisions, specification of roles such as the leader role in university student travel group when comes to the decision making. The core of these models stays the same, as they are all the combination of individual travel preference but overlooked the group dynamic. Nguyen and Ricci (2017) pointed out by using conservational methods, adopting case reasoning and critiquing can better capture the group decision-making process.

As the current GTRSs have overlooked the significance of group travel motivations in the real group travel preferences and their needs for interactions, this study aims to propose a novel group travel recommender system model which will focus on specific groups by their social relationship connection (i.e. family with children, lovers and friends). Different social relationship brings great difference on travel preference as when travelling different significant others, the travel motivations vary. Furthermore, travel with family are divided into two subgroups, family with children, and travel with parents. The interaction in these groups can be varied different especially within family travel group and lovers' group. However, there is not enough literature to support how the differences are in the context of tourism destination and itinerary choices. This paper

intends to investigate how the influences are in terms of destination attraction choices will be needed within these identified groups.

PROPOSED APPROACH

At the beginning of the research, unstructured interviews will take place with interviewees who have self-organised group travel experience which provides in depth knowledge for understanding the interaction needs. By interviewing, an initial model of group interaction needs and group travel motivation framework will be built up.

Followed with text mining which aims at analysing the textual contexts for unveiling the hidden patterns and interpreted into actionable information (Fan, Wallace, Rich, & Zhang, 2006). The research aims to extract tourist online reviews with different groups (e.g., family, lover, and friend) for different types of attractions by dividing them into positive or negative opinions. By only collecting group travel reviews, the corpus cleaning of irrelevant articles and adverbs and lexicon based stemming process will be conducted. Text analysis based on words' frequency, topic-based modelling for sentiment classification will be adopted.

CONCLUSION

This research explores the group interaction needs and group travel motivations among group tourists in social relationships. By conducting qualitative interviews and travel online review text mining, the group tourists' preferences can be more clearly identified. It can further validate that group travel motivations are very trip-specific, situational and varying with different travel party (parties). These dynamic and varying group travel motivations have significance influence on the group tourists' preferences. In addition, this paper provides a solid conceptual foundation for design group travel recommender systems with the consideration of group interaction needs and group travel motivations.

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An Investigation on Innovation Barriers in Manufacturing Firms

(Work in Progress)

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ABSTRACT

This study conducts to find out the key barriers of innovation in the manufacturing firms and evaluates the impact of the lack of environmental resources, organizational structure, government support and stability in firm innovation. Data was utilized through the enterprise survey data developed by World Bank (WBES'2013) of manufacturing companies in Bangladesh using the Marginal and Ordinary least squares (OLS) regression models. Results indicated that institutional aspects, land and finance support, energy and political factors are the main barriers to the propensity of a firm to innovate. The implication is that firms are likely to improve their innovation performance as they increasingly reconfigure their obstacles with regard to strategy development and technological investments.

Keywords: Innovation, Enterprise Survey, Barriers, Manufacturing Firms.

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INTRODUCTION

With the influence of certain changes in the business environment, such as the growing importance of services, knowledge, creativity, the developments in information technology, digitalization, globalization, and the surge of intellectual property, a new kind of economy has been created. In this new economy, value creation ability has shifted from tangible resources to intangible resources such as knowledge, creativity, unique organizational culture, corporate reputation, innovation, brand and design (Carmeli & Tishler, 2004; Surroca et al., 2010; Kor & Mesko, 2013). Many businesses have replaced their product and service concepts with more creative and innovative ways so as to achieve competitive advantage in the markets because of competitive pressure. The majorities of business firms in less-developed countries like Bangladesh are small and medium-sized manufacturing companies and face various challenges including skilled human and financial capabilities, a poor infrastructural base, and government policies and politics which debilitate their innovation activities. Despite all these challenges, they are still making enormous efforts in embarking on various innovative activities despite their limited potential.

Most of the previous empirical studies on the determinants of obstacles of Innovation concentrated on large firms, and therefore, empirical studies on small firms remain rare and scanty. Perhaps the conclusion to be drawn from the above studies may be misleading and inconclusive when applied to manufacturing firms. Therefore, the present study covered the above lacuna identified in the literature by analyzing the determinants of obstacles for manufacturing firm's innovative behavior using a Bangladesh enterprises survey dataset.

LITERATURE REVIEW

Innovation as an outcome emphasizes what output is sought, including product innovation, process innovation, marketing innovation, business model innovation, supply chain innovation, and organizational innovation. Firms should expect some forms of ex-post market power which prevents the limitation of the new products and processes and thereby allows them to recoup their research and development (R&D) expenses and move towards innovation. Innovation has always played a critical role in predicting the long-term survival of organizations (Ancona and Caldwell, 1987). More recently, there has been the development of new data sources like the Enterprise Data Survey (EDS) by the World Bank. These new data sources have induced many empirical studies, especially in the developed countries, on the determinants of a firm's innovation (Artes, 2009; Cohen & Levinthal, 1990; Fabrizio, 2009). These studies have identified a vast and complex set of firm-specific, industry-specific and economy-wide factors that are found to be influencing innovation activities both in developing and developed economies. However, the extent to which these factors are influencing innovation, particularly in developing countries like Bangladesh, still remains an open question.

Van Dijk, Den Hertog, Menkveld, and Thurik (1997) explained that innovation will provide firms with large monopoly profits that are necessary to finance R&D and pave the way for the expansion of businesses. Cohen and Levinthal (1990), Romer (1990), and Van Dijk et al. (1997) finds out those small firms sometimes can be more innovative because they are most likely to benefit from the local market and from any R&D subsidy by government. Sometimes, it differs significantly due to the

influence of factors like the environment and capability, among others. Adoption of new ideas is mostly caused by the interaction of some factors within or outside all forms of networking (Rogers, 1971).

In another study for Tunisia, Choi (2015) analyzed with a GMM model and found that firm size, age, availability of technical staff, and participation in export have significant influence on innovation. Ruiz-Hortega (2017) in their study of the determinants of radical innovation in the hospitality and tourist industries in Spain used a sample of 215 firms and found that the structural dimension of social capital has a strong negative effect on radical innovation. Lee (2009) used a World Bank survey for nine industries across seven countries. The intensity of competition was proxied by the degree of market pressure perceived by each individual firm in both local and international market and the study found that a firm's innovation habit depends primarily on its level of technological competence. Similarly, Alder (2010) using data surveyed from 40 developing and emerging economies found that firms with more advanced technology compared to their competitors have more product innovation.

METHODOLOGY

The data used in this study were drawn from the Enterprise Survey conducted by the World Bank (WBES, 2013) in Bangladesh. The sample consisted of 1442 business establishments surveyed from April 2013 through September 2013. The Enterprise Survey covers several topics of the business environment as well as performance measures for each firm. Enterprise Surveys currently cover over 130,000 firms in 135 countries, of which 121 have been surveyed, and data were collected on each firm's experience and enterprise perception of the environment in which they operated. The Bangladesh Enterprise Survey is nationally representative being obtained randomly from 1442 business establishments, mainly from the manufacturing sector.

To realize the principal objectives of the study, quantitative techniques were applied OLS regression. Marginal and ordinary least square regression is employed to estimate product, process, marketing, and organizational innovations and obstacles variables given that the variables are binary dummies. Later, we have conducted a Probit and Tobit model. Thus, the OLS regression model can be specified as in Equation 1 and equation 2.

$$\Pr(i = 1/X + x_i) = \theta(\beta_0 + \beta_1 FCS_i + \beta_2 HCV_i + \beta_3 FIA_i + \beta_4 ICS_i + \varepsilon_i) \dots \dots \dots \text{Equation [1]}$$

$$\lnnvv_i^* = \beta_0 + \beta_1 FCS'_i + \beta_2 HCV'_i + \beta_3 FIA'_i + \beta_4 ICS'_i + \varepsilon_i \dots \dots \dots \text{Equation [2]}$$

where, with regard to a firm i , $\Pr(i)$ is the propensity for the firm to innovate, $\theta(\cdot)$ is the standard normal cumulative distribution function (cdf), FCS_i is a vector of individual characteristics, HCV_i is a vector of human capital variables, FIA_i is a vector of innovative activity, ICS_i is a vector of industry characteristics, and ε_i is an error term.

RESULTS AND DISCUSSIONS

The current study was categorized by splitting industry types into categories: manufacturing and service sectors and service retail. The distribution of Firms in Bangladesh is depicted in Table 1 by their size based. This survey includes 1442 firms in Bangladesh, clustered by Dhaka, Rajshahi, Chittagong, Khulna where 34.53 percent (498) of them were small-scale firms. Table 1 also indicates that about 35.71 percent of the total firms operated at the medium scale, whereas 29.75 percent (429) of the total firms surveyed were large-scale firms. It is quite clear that the Bangladesh business environment is dominated by small-scale and medium size firms, but large-scale firm are on the race which is indicating as a developing countries' feature.

Table 01: Distribution of Bangladesh Firms Classified by their size

Firm type	Frequency	Percentage
Micro/Small	498	34.53
Medium	515	35.71
Large	429	29.75
Total	1442	100.00

Authors' Construction using WBES data

Table 2 express the product, process, organizational, marketing and R & D innovation by taking considering the firm size in Bangladesh. Moreover, firms are innovating in marketing strategies were the largest (71.5% of the total sample) scale followed by product innovative firms (36.3%), then process innovative firms (32.7%) and lastly organizational innovative firms (14.9%). Only 16.6 percent of the sampled firms invested in R&D. In addition, this table indicates that large and medium-scale enterprises were the most innovative where microenterprises were the least innovative. With regards to firm sector, manufacturing firms were the most innovative followed by service firms and lastly retailing firms. It could be inferred from this information that small- and medium-scale enterprises or manufacturing and service firms are the engine of innovation in Bangladesh.

Table 02: Percentages of Innovation by Firm Type and Sector

Type of Innovation	By Firm type (Percentage)
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	Full sample	Small/Micro	Medium	Large
Firm type				
Product	36.3	32.6	41.5	48.6
Process	32.7	28.4	38.2	46.7
Organizational	14.9	10.2	17.9	28.8
Marketing	71.5	65.2	82.9	91.9
R & D	16.6	12.4	21.3	30.8
By firm sector (Percentage)				
	Retail	Service (non-retail)	Manufacturing	
Product	25.2	34.5	39.6	
Process	52.7	31.9	36.7	
Organizational	10.3	13.1	14.9	
Marketing	38.9	71.1	72.6	
R & D	7.2	14.3	18.8	

Authors' Construction using WBES data

Table 3 contains the estimated ordinary least square models on the determinants of the barriers of innovation (product, process, organizational, and marketing innovation) at the firm level in Bangladesh. The OLS model of barriers to product innovation showed that the significant determinants of a firm's chances to minimize the barriers. Model 1 indicates that a percentage of acc_land and acc_finance are positively impact in obstacles to innovate a product by 7.7 and 6.17 respectively.

Moreover, corruption (8.3%) and politics 13%, also have significant percentage and positively related to firms' innovation. The model shows that retail and service firms are less likely to invent a process than manufacturing firms by percentage points. Model 3 in Table 3 also indicates that age, energy, employee education, lack of formal training are the significant obstacles of organizational innovation at the firm level in Bangladesh. Specifically, a percentage increase in the age and size of a firm causes the firm to innovate an organizational structure by probabilities.

Table 03: Barriers of Innovation using OLS model

VARIABLES	(1) ProductInno	(2) ProcessInno	(3) OrgInno	(4) MarkInno
Ln_age	-0.74359 (3.24474)	-0.28572 (3.27965)	-4.94527 (3.36256)	0.97190 (3.22700)
F_Ownership	-0.27736 (0.26744)	0.12481 (0.27032)	0.12292 (0.27715)	0.00667 (0.26579)
D_Ownership	-0.39943 (0.32609)	0.17263 (0.32960)	0.08972 (0.33793)	0.28396 (0.32398)
G_Ownership	0.66679 (0.51833)	0.18832 (0.52390)	0.19343 (0.53715)	0.31463 (0.51500)
Export	0.22595** (0.09348)	0.09998 (0.09449)	-0.04183 (0.09688)	0.18737** (0.09289)
Competitors	0.00383 (0.11200)	-0.10341 (0.11320)	-0.12402 (0.11606)	-0.36487*** (0.11507)
RD	0.27137*** (0.06416)	0.10911* (0.06485)	0.18692*** (0.06649)	0.26734*** (0.06374)
Ln_Size	0.01098 (0.02361)	0.03403 (0.02387)	0.05211** (0.02447)	0.01497 (0.02346)
EmployeeEdu	0.00066 (0.00107)	0.00019 (0.00108)	0.00096 (0.00111)	0.00090 (0.00106)
ln_FemaleEdu	0.15160*** (0.05192)	0.21921*** (0.05248)	-0.01171 (0.05381)	0.15832*** (0.05159)
F_Training	0.02780 (0.06106)	0.14293** (0.06172)	0.08291 (0.06328)	0.11032* (0.06069)
Micro = o,	-	-	-	-
Small = o,	-	-	-	-
Medium	-0.05111 (0.05699)	-0.08655 (0.05760)	-0.05154 (0.05906)	-0.08395 (0.06934)

Large	-0.04245 (0.08474)	0.05105 (0.08565)	0.09516 (0.08782)	
Acc_Finance	-0.12059 (0.07753)	-0.00564 (0.07837)	0.10985 (0.08035)	0.01705 (0.07703)
Acc_Land	0.06479 (0.06170)	0.25159*** (0.06236)	0.22622*** (0.06394)	0.25956*** (0.06130)
Corruption	0.05697 (0.08361)	-0.17183** (0.08451)	-0.04009 (0.08665)	0.04562 (0.08308)
Energy	-0.28000** (0.13084)	-0.11010 (0.13225)	-0.07164 (0.13559)	-0.15393 (0.13001)
Political_Ins	-0.13628 (0.13432)	0.03853 (0.13576)	-0.04788 (0.13919)	0.13260 (0.13346)
Small				-0.10276 (0.08439)
Large = o,				-
Constant	6.44391 (24.71443)	1.99770 (24.98033)	37.58781 (25.61185)	-7.50058 (24.57437)
Observations	390	390	390	389
R-squared	0.17306	0.22556	0.15831	0.25250

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

CONCLUSIONS

Major obstacles of a firm's innovation in Bangladesh, using the WBES dataset was kept as a prime intention of this study. To realize the objectives of the study, the binary techniques OLS regression models were used. The study produced some stylized facts regarding constraints of innovation in Bangladesh. It established that the major determinants of product, process, organizational, and marketing innovation along with the major barriers as like politics, infrastructure, and energy issues in manufacturing firms. The policy implications of the study are that any firm that desires to be innovative in any of product, process, organizational structure, or marketing should pay much attention to R&D investment with reducing barriers. Specifically, for firms to strengthen organizational innovation, they should also engage in minimizing the internal and external obstacles for innovation in Bangladesh context.

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Application Analyses of Visual Information Processing Techniques in E-Commerce

(Work in Progress)

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ABSTRACT

Digital visual information plays a very important role in E-Commerce (EC). Their usage brings forth many novel research topics for digital visual information processing skills and software. Some issues of application analysis of image/video information processing techniques suitable for EC are described in the paper. Visual design for goods or services trading, image retrieval based on visual contents, applications of images to the trade safety on the Internet, 3-dimensional display, virtual reality for goods browsing, inquiry based on image and video contents, trade safety and copyright protection of digital works based on digital watermarking are mainly discussed which are considered as the technological solutions that could enhance EC.

Keywords: Electronic commerce, visual information, plane design, goods exhibition, visual retrieval, trade safety, digital works.

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INTRODUCTION

Nowadays, shopping or marketing is made easier with the Internet than in shopping centers or supermarkets. It can stimulate consumption by boosting trade volume, and reducing the corresponding cost. The e-commerce market continues to grow steadily. For example, according to data from the US Commerce Department and US Census, "in the first quarter of 2019, the share of e-commerce in total U.S. retail sales was 10.7 percent, 9.8 percent up from the corresponding quarter in the previous year. As of that quarter, retail e-commerce sales in the United States amounted to almost 146.2 billion U.S. dollars." (Statista, 2019). In China, there are 74.8 percent (i.e., 63.882 millions) users shopping on webs according to the census conducted by China Internet Network Information Center (CNNIC), August 2019. From June 2016 to June 2019, users of online food delivery increased from 14.627 million to 41.744 million. In the first half of 2019, retail e-commerce sales amounted to ¥5.48 trillion, while in 2017, retail e-commerce sales were ¥3.82 trillion (CNNIC, 2019). Since the history of E-commerce is relatively short compared to that of traditional business methods, it still has some problems to be solved. For example, B2C websites lack enough information for buyers, especially detailed images or vivid pictures of the goods to be sold. Security procedure is a more serious factor to be considered. Another problem is related to the copyright of digital image and video works called digital works. Of course, there will be new problems and challenges in the future.

Visual information can be understood easily by a wide range of people, regardless of their educational backgrounds or lifestyles, except for blind persons of course. Broadly speaking, visual information mainly means image information, including images, graphics, animation, video, which belongs to multimedia information., Their processing technologies also include visual surveillance, human-computer interfaces, 3-D video, etc. (BU Electrical & Computer Engineering, 2017). One example is images used in advertisements for products in E-commerce websites. They can be treated as references or mimic reflection of real entity, which is more expressive in showing itself than popular character explanation, especially for residents in rural regions of China and other developing countries. Furthermore, trademarks file to protect the interests of manufactures is another typical use. With the rapid development of computer and telecommunication technologies especially very large scale integrated (VLSI) circuits, hardware integration and miniaturization, liability increases while their prices decrease. Equipment used in visual information collection, transition, storage and display is easier to operate. Recent years have seen more innovations in the application of internet techniques, software tools, visual operating systems and convenient multimedia information interfaces, which has resulted in the steady increase in the use of image and graphics software tools. Therefore, visual information resources extend over a broad domain of life. Besides entrepreneurs and customers, investors and administrators also need them. In the area of usage of image information in EC, where interactive visualization interfaces are used for revealing structures, and navigating an increasingly large and complex amount of data and information, customers demand quick and correct querying, accessing, and information retrieval. However, Nisar & Prabhakar (2017) pointed out that "e-commerce still faces challenges compared with traditional offline retailers since customers cannot feel and try the products, and may end up choosing the products that they do not want" (P.135). Visual information technology will not be a help to EC if the users cannot use it easily and efficiently. Some issues of the application of visual information to EC are discussed in the following sections, which are considered as the technological solutions that may enhance EC.

IMAGES USED FOR GOODS OR SERVICES TRADING

Technologies of image processing and virtual reality (VR) can give the consumers a direct view of goods and a virtual browsing effect. All consumers want a clear look at goods before buying them. When customers visit some websites, usually they want a full view of the product, from all angles. VR modeling language (VRML) is required to construct an exhibiting

hall and goods shelf so that people can see the goods they are interested in in the same way as if they were in ordinary shops. In order to achieve this effect, some software techniques using 3-dimensional image and digitalization are used. 3-dimensional modeling and the production of images and graphical software systems have the ability with good quality. Their reproduction methods give us a vision of an almost realistic realm.

With image processing and VR techniques, personal body movement has the principal role of controlling browsing. The representation changes with the manipulator's action. VR techniques can create a world where the user can get in and move freely. Goods' appearance could be observed from different directions, thus trading in this world avoids some blindness. Geographical information systems combined with 3-dimensional graphics and image navigating presentation skill allows buyers to search for goods rapidly and see them in detail. The following implementation stages are the basic requirements, i.e., model building and indoor scenes that existed or to be constructed; deploying colors with models and its variations; adding illuminations; imposing background scene and colors. Thus, customers can arrive at a user-friendly screen where browsing, selecting, and cashing out are available. Besides selling tickets or offering discounts through its website, a company needs to show images and videos of its facilities, set up online games that relate to and increase its offerings over the Internet (Entrepreneur, 2018). On the other hand, customers want to browse service effects such as home textiles exhibition, fitting and hairstyle, etc. over the Internet. Dealers are trying to use some specialized image software to show the real effects for some online services, as shown in Figure 1, which could be used in EC websites. Visual information processing software used for online services is under way nowadays.

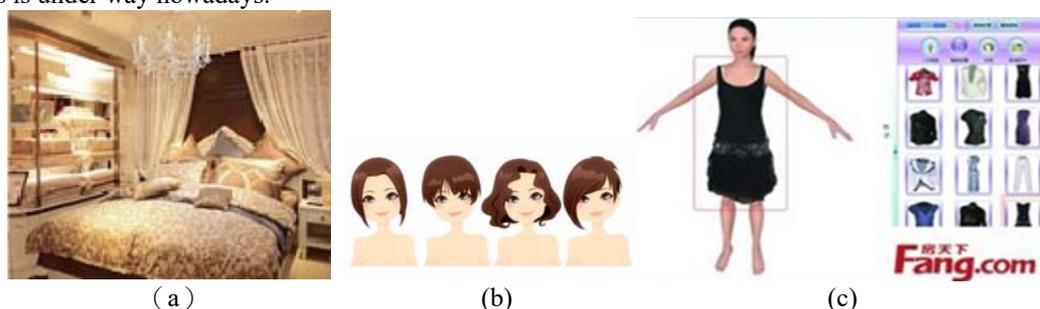


Figure 1 Some applications showing goods exhibition and service effects for (a) home textiles exhibition, (b) hairstyle and (c) fitting

IMAGE PROCESSING TECHNOLOGY FOR E-COMMERCE

Visual Design Used For E-Commerce

Essentially, e-commerce is the buying and selling of goods (or services) on the internet so that the e-commerce platform design for the sellers or business are important to their selling activities. As we all know, the plane design has a broad application in all walks of life and its techniques are essential to design and innovation, involving architecture, advertising, publication, model, etc., especially in the EC environment. Some common image processing design software, such as Adobe Photoshop can modify image, model and form style specification etc.. In fact, there are more than fifty image processing softwares on the internet. Graphic design software in e-commerce design, for example, CorelCAD, Flash, etc. are excellent two and 3-dimensional drawing and design tools which can achieve our goals.

Plane design is necessary to support goods data analysis of EC websites. Who bought your goods? Whom your things are more popular with? What do they like? What about their professional income level? All of these are based on the data statistics that can be targeted to serve their customers with more graphical explanation. The visual design procedures are most significant to connect sellers with would-be buyers who use the Internet to browse their targets.

Instead of converting to real objects, e-commerce websites mainly rely on various electronic advertising screens, such as computer /pad/ mobile phone/TV, etc. Further, the design of some buttons should be very exquisite, which involves the knowledge of experience and emphasizes the interaction between customers and the equipment.

Retrieval Based On Visual Contents In EC

Image retrieval based on visual information can facilitate the customers to know the commodity at distance through communication networks, thus extending the seller's market space. Undoubtedly, researches on the technologies of image and video extraction, processing, rearrangement, organization of formats and displaying impulse the application of visual information retrieval technologies that gradually enter the market as its maturing. With many different kinds of goods available at various websites, buyers want to gain a quick knowledge of the pertinent information about their models and specifications. If retrieval skills allow buyers to go down through interesting scenes to their targets, it would be typically useful in the shopping process. Theoretically, contents-based retrieval extends the concept of the traditional searching mode which is based on text message or expression formula. If websites were facilitated both the content-based and text-based approach, they would be superior to querying with single text-based mode. Also it improves interaction with customers' feedback.

APPLICATIONS OF IMAGE RECOGNITION FOR TRADE SAFETY

After the buyers select satisfactory goods, payments are due to the sellers. Therefore, ensuring the trading security, especially of the online transactions, is the next essential task for EC. The main concern of customers while buying goods from the online markets is the same safety and reliability as ordinary market trading. It usually involves two aspects: the genuineness of advertised products, and the safety of personal payment.

Currently, the conventional processing methods include using an algorithm of encrypting and deciphering such as DES and RSA, digital signatures depending on the certificates issued by some reliable organizations. They are acquired and recognized before data exchanging. From a theoretical point of view, these measures could meet the requirements for safety and validity to some extent. However, with the rapid evolution of EC, there appear a lot of hidden safety and reliability issues in practice. For example, the data on a credit card and the sensitive information could be embezzled occasionally. According to a report released in (CNNIC, 2017), there have been discovered more than 40.3% shopping frauds out of all online frauds in China. Because encrypting and deciphering algorithms have some shortcomings themselves, they somewhat hinder the further promotion of EC until they overcome the above weaknesses. The alternative considerations are taken in the user-proof scheme in case of illegal accessing happened. Automatic face recognition has a great potential in security system access control, video surveillance, face photos matching for law enforcement and duplicate ID card detection. The biometrics-based algorithms involve verifying the identity of a specific person based on behavioral or physiological aspects of activities that occur on a computing device. This is mainly because of its flexibility and simplicity to use besides its safety. The end users can log in by pressing your finger or swiping your face without even spending much time to remember long and difficult passwords. Microsoft's Hello and apple's Face ID are two popular applications that the future of authentication lies in biometrics. Currently, ten different biometrical features i.e. DNA, face, fingerprint, hand geometry, hand vein, iris, retinal pattern, signature, voice-print, and facial thermogram, are under intensive investigation. These are inherently more reliable than traditional authentication methods such as passwords and PIN numbers. Each of the biometric-based techniques has various advantages and disadvantages (Rani & Saurabh, 2014). Properties comparisons among several biometrical features used in practice that are listed in Table 1.

Of course, people cannot just rely on biometric features, otherwise there will be confronted with the problems of password verification systems again. Moreover, in the case of biometric authentication, if users' fingerprints or facial features are stolen, there is no way to use longer such system for authentication. More recently, Kittur & Pais (2017) investigated verification of digital signatures for the purpose.

Table 1: depicts the properties rank of several biometrical features used in real world applications.

Rank	Exactness	Convenience	Cost	Integration Level
1	Deoxyribonucleic Acid(DNA)	Face	Signature	Finger-print
2	Iris	Signature	Finger-print	Face
3	Retinal pattern	Finger print	Face	Signature
4	Finger-print	Iris	Iris	
5	Face	Retinal pattern	Retinal pattern	Iris and Retinal pattern
6	Signature	DNA	DNA	DNA

PROTECTIONS OF COPYRIGHTS OF DIGITAL WORKS

Copyrights Of Digital Works And Digital Watermarking

With the progress in design and development of new input devices in computer, various forms of information with the original format such as articles, images, speeches, etc. can be easily input and output in the form of binary codes. However, when there is a need to the original form of information, they could be reformed again using the corresponding technique. Digital works include digital content of online books, graphics, films and TV videos, photos, paints (Chen & Liao, 2011) and computer games, virtual items purchased within computer games, computer software, mobile phone apps, etc. (Businesscompanion, 2015). Usually, they are transmitted or shared on websites, and, obviously, exposed to unauthorized attacks such as forgery, plagiarism, and tampering (Halbheer, Stahl, Koenigsberg, et al., 2014). So, it is obvious that ownership of digital contents is an important issue in information management systems. The main reason for the engagement of users with the E-commerce technology depends on safety system level, safety code and safety perfectness. Protection of intellectual property of digital contents has become crucial in the widespread and rapidly growing use of digital media.

To solve such problems, digital watermarking has received much attention from academia and industry researchers for addressing the copy tracking, copyright protection, and content authentication recent years. Digital watermarking is the process “that embeds data called watermark into a multimedia object (such as text, audio, image and video) such that watermark can be detected or extracted later for affording an assertion about the watermarked object” (Jane, Elbaşı & ilk, 2014. P.750). However, it is not enough to merely hide information within digital works. How to justify the copyright claim without revealing any secret information and prevent the owner from deception is a central issue in the ownership disputes. Researchers have proposed some feasible schemes of proving ownership, in which performance has improved. Asymmetric watermarking schemes, zero-knowledge watermark detection and so on are studied (Chang, Tsai & Yen, 2016; Ansari & Pant, 2017). For digital watermarking, a number of different characteristics of the watermarking process and the watermark are desirable.

Anti-Counterfeiting Trademark Image

A trademark is a pattern formed by combining letters, numbers, graphics, text, colors and three identifying characteristics in commodity packaging and service marks. It is a microcosm tailored to the image of an enterprise or the commodities it produces and manages at the very beginning, which can show the name of the enterprise or commodity, the geographical location of the enterprise and even the enterprise culture. As commodities from all walks of life appear in the market one after another and are constantly upgraded and optimized, the competition on brands is also increasingly fierce. In order to consolidate or win a larger market share and prevent competitors from imitating themselves, many high-quality old brands and emerging creative brands have optimized their trademarks. The appearance of digital watermarking anti-counterfeiting technology, to some extent, not only can make trademark copyright holders get better protection, but also can enhance users' trust and dependence on enterprise products, maintain users' market share and enterprise's economic image.

In brief, the making process of the digital watermark anti-counterfeiting trademark is the anti-fake information (product serial number, production date, origin or enterprise information, etc.) through the HASH function to calculate the HASH value, and the use of digital watermarking processing system will be embedded in the trademark in the electronic design manuscripts, after workers check can be put into print production (Zhu & Zhong, 2004). In the process of market circulation, when consumers or supervisory departments find suspected counterfeit products, they can verify the trademarks through specific trademark watermark detector, so as to distinguish genuine products from fake products.

Watermarking Of Videos

Video image data has a strong correlation, meaning that there exist a large amount of redundant information. To reduce the redundant data from video files, the data compression technology is used to remove the correlation between data). Currently, the most important codec standards of video streaming are H.264, H.265 and HEVC. H.265 is the new video coding standard developed by ITUT-T VCEG based on H.264 (Dutta & Gupta, 2017. As for compressed domain processing, Hartung and Girod (1998) pointed out that even though many applications for watermarking of compressed video, it is desirable property if uncompressed video could compatibly be watermarked without having to encode it first, as shown in Figure 2.

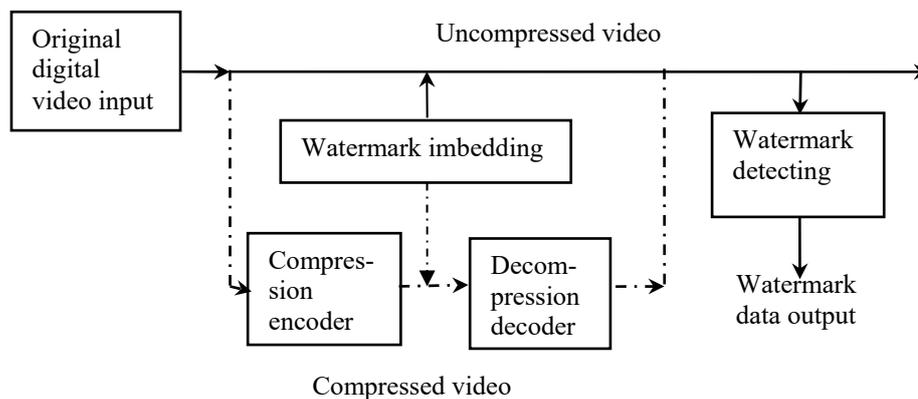


Figure 2. Diagram of watermarking in the uncoded and coded domain of videos.

The watermark signals are designed to embed in some areas of video frames to benefit the video stream server, including decoding, processing and re-encoding. In order to get a better effect in watermark embedding for copyright protection, some other researchers use the characteristics of the human visual system as well as the inherent characteristics of a video in the frequency domain, with the help of some mathematical transformations and the latest multimedia communication technology (Subramanyam & Emmanuel, 2014; Selvam, Balachandran, Iye, et al., 2017; Al-Haj, Farfoura & Mohammad, 2017).

CONCLUSION

The information technology revolution is not only changing the production and operation mode in modern industries and tertiary industries, but also changing the traditional commercial modes in cities and rural regions. In this paper, visualization, i.e. the application of image and video together with artistic character graphics to EC is discussed. As long as many websites use the above information in the services, individuals will get more profit from these advanced information technologies.

Therefore, digital visual information plays a very important role in E-Commerce, tourism and restaurant, hotel, etc. Moreover, their usage brings forth many novel research topics for digital visual information processing skills and software. More attention should be paid to the research of more image techniques such as multimedia, Human-Computer Interaction, AI and so on in the EC field in order to ensure the healthy and rapid development of the art. Our further concerns in this field are to promote more application of images and videos in agricultural E-commerce and better interaction with customers' feedback.

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Factors Affecting Continuance Intention of Mobile Government Services

(Work in Progress)

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ABSTRACT

There are potentially substantial benefits of mobile government (m-government). From a government perspective, m-government can help in increasing efficiency and effectiveness as well as reducing government spending; from the citizens' perspective, m-government can help in providing real-time information access and personalized services. However, the low level of usage prevented both governments and citizens from realizing the potential benefits of m-government. As a result, researchers have studied the factors affecting the acceptance of m-government. However, to date, none have considered the factors that affect the continued use of m-government. We argue that investigating these factors will provide a greater insight on why the potential benefits have not been realized. The theoretical foundation of the proposed model builds on the Expectation-Confirmation Model (ECM) and Information System (IS) Success Model. This research-in-progress paper reports on research methodology and expected contributions.

Keywords: mobile government, continuance intentions, satisfaction, confirmation, trust.

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INTRODUCTION

Recent years have seen the implementation and launch of more and more m-government services. These services aim to deliver both information and services to the public. They include, but are not limited to, citizens receiving notifications via Short Message Services (SMSs) about their children vaccinations (Bushar et al., 2017) and paying for public transport using their mobile phones (El-kiki et al., 2005). M-government can benefit both governments seeking high efficiency and effectiveness as well as low government spending (Al-Khamayseh & Lawrence, 2006) and citizens looking for real-time information access and personalized services (Althunibat & Sahari, 2011). As the uptake of m-government services by citizens is below expectations in many countries such as Greece (Karatzika et al., 2012), India (Saxena, 2017), and Tanzania (Mandari et al., 2017), these benefits are far from being realized. This phenomenon has led researchers to investigate factors that hinder the diffusion of m-government (Saxena, 2017). Most of these studies have focused on identifying the factors that affect the initial acceptance decision, assuming that initial acceptance automatically leads to continuance use. However, others argued that initial acceptance does not necessarily create the anticipated outcome without adopters moving beyond first-time use and becoming continued users (Wangpipatwong et al., 2009). Bhattacharjee (2001) also pointed out that the eventual success of an information system (IS) is determined by continuance use rather than first-time use. Furthermore, the importance of investigating factors affecting the continued users over initial adopters is mentioned in a common rule in the business; retaining a customer is five times cheaper than acquiring a new customer (Tsao, 2013; Tsao et al., 2012). We argue that factors affecting continuance use differ from those, which affect acceptance and investigating the former will provide a greater insight on why the potential benefits have not been realized. Therefore, this research aims to bridge the gap by investigating the factors that affect continuance use of m-government.

This study applies, the ECM, which has not yet been tested in the context of m-government, as well as IS Success Model and attempts to answer the following research question:

What are the factors that affect the continuance intention to use m-government?

RESEARCH BACKGROUND

Definition of M-government

The term m-government has several definitions. Kushchu & Kuscu (2003) defined m-government as "a strategy and its implementation involving the utilization of all kinds of wireless and mobile technology, services, applications and devices for improving benefits to the parties involved in e-government including citizens, businesses and all government units." Interestingly, they add that although m-government is significant, it can only be seen as a subset of e-government. Then m-government has been defined by Antovski et al. (2005) as "getting public sector IT systems geared to interoperability with citizen's mobile devices". Misra (2009) stated that "m-government is public service delivery including transactions on mobile devices like mobile phones, pagers and personal digital assistants (PDAs)." Zefferer (2011) reported that, although researchers provide slightly different definitions for m-government, they almost all agree on the fact that m-government utilizes mobile technologies for the provision of public services.

M-government Acceptance Models

Over the past few decades, a number of theories and models have been established in the acceptance of new information technologies. Many of these models have been used to examine the acceptance of m-governments (Ajzen, 1991; Davis, 1989). The most commonly used in the context of m-government are Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975), Theory of Planned Behaviour (TPB) (Ajzen, 1991), Technology Acceptance Model (TAM) (Davis, 1989), Diffusion of Innovations (DOI) (Rogers, 1995) and Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). Different models focus on different factors such as social influence, usefulness and compatibility. Table 1 presents each model with its factors and an example of a study that employed the model to investigate the acceptance of m-government.

Table 1: Most common models, their factors and citation of studies adapted these models.

Model	Factors	Studies
TRA	Attitude, Subjective norm	(Althunibat & Sahari, 2011)
TPB	Attitude, Subjective norm, Perceived behavioral control	(Susanto & Goodwin, 2013)
TAM	Perceived usefulness, Perceived ease of use	(Almarashdeh & Alsmadi, 2017)
DOI	Relative advantage, Compatibility, Complexity, Trialability, Observability	(Abdelghaffar & Magdy, 2012)
UTAUT	Performance expectancy, Efforts expectancy, Social influence, Facilitating conditions	(Baabdullah et al., 2017)

Most m-government acceptance studies employed one or more models from Table 1. These studies implicitly assume that acceptance automatically leads to continuance of use. However, many researchers criticized these models for not being able to explain discontinuance of use after the initial acceptance (Karahanna et al., 1999). Bhattacharjee (2001) argues that these models ignore the fact that perceptions change after initial use and over the time. Tornatzky et al. (1983) added that although acceptance is one of the pre-requisites of continuance use, aspects that influence acceptance may have no influence on continuance use. For example, social influence can affect the acceptance decision. However, social influence effect decreases after using the system, especially if a user is dissatisfied (Triandis, 1971). Another good example is that ease of use can affect the decision to accept a new system. However, after the first use and after gaining experience with the system, ease of use influence decreases (Karahanna et al., 1999). As a result, to gain deeper understanding on the factors that affect continuance use, it is essential to employ models that are more relevant to post-acceptance stage. These models are discussed in the following sections.

Expectation-Confirmation Model

The Expectation-Confirmation Model (ECM) was developed by Bhattacharjee (2001) to investigate the factors affecting the continuance intention of ISs. A significant amount of research has empirically tested ECM, it was found that both confirmation and perceived usefulness determine satisfaction, which in turn influences IS continuance intentions. Although ECM is widely used and has been validated in a range of different contexts, like mobile banking (Jusuf et al., 2017) and social networking sites (Hur et al., 2017), no study to date has adapted the ECM in the context of m-government.

To increase the explanatory power of the ECM, we have extended it by incorporating another model—the IS Success Model—and the external factor of trust. This amendment is to answer a call by Hung (2012) to extend the ECM.

IS Success Model

The IS Success Model is a success-measurement framework widely used in the IS field (DeLone & McLean, 2003). Some researchers regard the model as a breakthrough in the IS field (Fang et al., 2011). The IS Success Model and ECM are similar in two aspects: first, they both provide deeper insights into system success and sustainability, rather than just initial acceptance, and second, they both emphasize the importance of users' satisfaction in determining users' behavior. The proposed model incorporates some constructs from the IS Success Model, namely information quality, service quality, and system quality. These constructs were tested in the IS field and were found to have a positive influence on users' satisfaction (Zheng et al., 2013; Yang et al., 2017).

RESEARCH MODEL

The proposed model for this research has been developed based on ECM. The theoretical model also incorporates some aspects of the IS Success Model—namely, information quality, service quality, and system quality. Trust is an external factor that has been incorporated in the model, as it has been proved to be an influencing factor regarding IS continuance (Zhang et al., 2018).

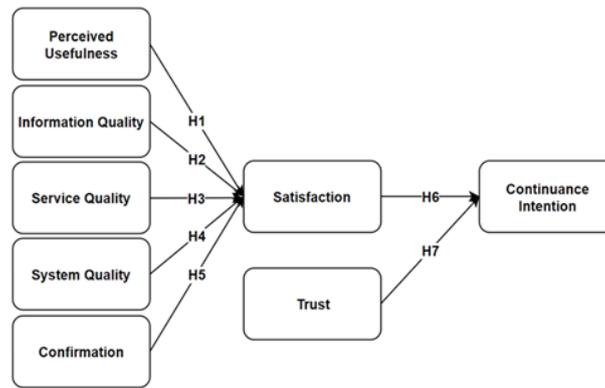


Figure 1: The proposed model of m-government continuance intentions.

Testing this model empirically should enhance our understanding of the low level of usage phenomenon.

RESEARCH HYPOTHESES

Table 2 defines the relevant factors and formulates the hypotheses of this research. The definitions were modified to fit purpose of this study.

Table 2. Factors, definitions, supporting studies, and hypotheses.

Factor	Perceived Usefulness
Definition	The degree to which users believe that using m-government would improve their performance (Davis, 1989).
Supporting studies	Online communities (Apostolou et al., 2017), digital textbooks (Joo et al., 2017), mobile payment (Park et al., 2017), and electronic learning (Ifinedo, 2017).
Hypotheses	H1: Perceived usefulness positively affects satisfaction.
Factor	Information Quality
Definition	The degree to which the information that m-government provides adequately meets users' requirements (Chang et al., 2005).
Supporting studies	Online communities (Apostolou et al., 2017), social networking sites (Dong et al., 2014), mobile banking (Chung & Kwon, 2009), and electronic learning (Lin, 2007).
Hypotheses	H2: Information quality positively affects satisfaction.
Factor	Service Quality
Definition	The degree to which the method of delivering a m-government service is excellent and superior (Parasuraman et al., 1985).
Supporting studies	Electronic learning (Lin, 2007) and mobile commerce (Kuo et al., 2009; Sensuse et al., 2017)
Hypotheses	H3: Service quality positively affects satisfaction.
Factor	System Quality
Definition	The degree to which m-government functionalities can be learned and utilized with as few errors as possible (Chen et al., 2015).
Supporting studies	Online communities (Apostolou et al., 2017), social networking sites (Dong et al., 2014), mobile banking (Chung & Kwon, 2009), electronic learning (Lin, 2007), and mobile commerce (Gao et al., 2015).
Hypotheses	H4: System quality positively affects satisfaction.
Factor	Confirmation
Definition	The degree to which a m-government service's performance meets users' expectations (Bhattacharjee, 2001).
Supporting studies	Mobile services (Chen et al., 2013) and electronic medical records (Mettler, 2012).
Hypotheses	H5: Confirmation positively affects satisfaction.
Factor	Satisfaction
Definition	The degree to which users have a positive affective orientation toward m-government; i.e., the degree to which they feel good about it (McLean, 1992).
Supporting studies	Online communities (Apostolou et al., 2017), mobile commerce (Gao et al., 2015; Sensuse et al., 2017), social networking sites (Dong et al., 2014), and electronic learning (Lin, 2007).
Hypotheses	H6: Satisfaction positively affects continuance intention.
Factor	Trust
Definition	The willingness to be vulnerable to an action that a trusted party takes according to feelings of confidence or assurance. (Mayer et al., 1995).
Supporting studies	Electronic health (Zhang et al., 2018).
Hypotheses	H7: Trust positively affects continuance intention.

RESEARCH METHODOLOGY AND EXPECTED CONTRIBUTIONS

The proposed model will be tested by collecting quantitative data using an online survey method. As this study aims to examine the factors affecting the continued use of m-government services, only people with experience in m-government will be included in the sample.

This research is expected to make valuable contributions. It proposes a model based on the ECM, which contributes to IS continuance by validating the ECM in a new context (m-government), and it extends the ECM by incorporating external constructs. Furthermore, this research is the first to investigate the factors affecting continuance use in the context of m-government.

The research is also expected to make practical contributions to policy makers through recommendations on how to improve their m-government services in order to increase the level of utilization by citizens and to realize the potential benefits of m-government.

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Going Digital: SMEs Based Food E-commerce Engaging Customer through Customer Needs-Driven

(Work in Progress)

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ABSTRACT

This study explores food e-commerce engages customer to their needs, wants and lifestyle towards food purchase in the transition of retail revolution era. The focus is given to the customer engagement for co-creation process from the seller's perspective. The study was carried in Indonesia by applying an inductive research approach using in-depth interviews with multiple food e-commerce company's management (n=8). A six-stage of thematic analysis was applied using NVivo 12 software. The study showed that customer curiosity, customer buying behaviour change, customer food lifestyle changes and more demanding consumers underlying customer-needs driven. The SMEs proactively respond to consumer needs by communicating the expected benefits of food purchase via online channels. It activates the role of customer as value co-creator through familiarising food shopping based-online channel and experiencing the food online channel usage. The process of B2C value co-creation of food e-commerce is described as a process of gaining customer attention, role understanding, interaction, learning, intervention and making consumers discover. The transition stage of retail revolution of SME-based food e-commerce in developing countries demonstrates a conceptual process of value co-creation while exploring the customer needs-driven to this specific context. Both scholars and practitioners could learn from consumer behaviour changes displayed on online food purchase by managing each role and resources accordingly.

Keywords: value co-creation, customer engagement, customer needs-driven, SMEs, food e-commerce

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INTRODUCTION

The worldwide penetration of internet utilisation has impressively increased the number of technology-savvy consumers including modify consumer shopping behaviour. The emergence of e-commerce is evidence of a shopping revolution in a problem-solving process that changes the way buyer-seller interaction and transaction (Saba, Rolandi, & Pilloni, 2017). Electronic commerce has also influenced food retail evolution by continuously change the brick and mortar stores to virtual stores as alternative food networks (Bryła, 2018; Lee, Jeong, Cho, Jeong, & Moon, 2015). The conventional food distribution and retails with long fragmented business process have driven a prospect for food e-commerce (Leroux, Wortman, & Mathias, 2001). The penetration of e-commerce to compete in the retail markets offer the advantages on cost of travel and shopping time with supply chains efficiency (Liang Lu & Reardon, 2018).

However, different features show on the adoption of e-commerce applies for agri-food industry between developing or emerging economics countries and developed countries concerning the company size. Small scales enterprises (SMEs) are dominated the online commerce in developing countries (Zhang, 2017), whereas global corporation dominating the e-commerce in developed countries (Henderson, Dooley, Akridge, & Carerre, 2005). Consumer and producer characteristics in developing countries request for synchronising profit, well-being and sustainability in an inclusive community (Nahi, 2016). Fostering the SMEs based agri-food e-commerce, collaborative interaction becomes essential by engaging customers for mutual benefits in the long run (Saba et al., 2017).

Engaging customers by encouraging customers to contribute more resources in the purchasing process to provide with a better fit for their needs may deliver a broader services system (Jaakkola & Alexander, 2014). Customer needs-driven is a concept of managing and improving cooperative relationships with customers (Arnett & Badrinarayanan, 2005). The idea indicates as customer relationship management by engaging customers through with various ways customer behaviour including utilising customer experience and customer online dynamic behaviour (Pagani & Malacarne, 2016). The role of customer engagement by adopting customer behaviour beyond transactions may affect the company's ability to serve customers with multiple benefits to fit their needs (Jaakkola & Alexander, 2014). Accommodating customer needs in an inclusive or collectivist market along with social lifestyle changes and ICT adoption serve as other challenges. This study explores food e-commerce engages customer to their needs, wants and lifestyle towards food purchase in the transition of retail revolution era. The focus is given to the customer engagement for co-creation process from the seller's perspective. Less attentions are given to marketing

transformation of food commerce through electronic channels provided by SMEs by understanding their way to engage customers with unique value proposition. Specifically, it observes the implementation of customer relationship development to accommodate customer food buying changes through e-commerce and exploring the value generating process. Two research questions proposed in this study:

RQ1: How SME based food e-commerce engages the customer through customer needs-driven?

RQ2: How is customer value co-creation process adopted to introduce new food shopping channel with online stores?

METHODOLOGY

The study was applied inductive reasoning through in-depth interviews. The aim was to explore the understanding of the changes in consumer buying behaviour from physical stores to online stores by engaging customers and enables them to be the value co-creator. The focus is given on food e-commerce that operates by small-medium enterprises (SMEs) that sold fresh produce such as fruits and vegetables in Indonesia. By understanding customer needs-driven adopted by the informants could discover how SMEs based food e-commerce approach the urban community as the targeted market. Two potential locations of metropolitan cities in Indonesia namely Bandung and Jakarta were selected to trace the food e-commerce operation. As a result, eight interviews were carried out to facilitate the data collection (see table 1). The study gathers data through a semi-structured interview using purposive sampling. The sampling can provide the anticipated information by narrowing the targeted respondents to specific target groups (Sekaran & Bougie, 2016).

Table 1: Interviewees' Profile

Name	Business operations	Gender	Role in the company	Legal structure of the business
Interviewee 1	E-commerce supplier company and retailer	Female	CEO	Start-up company
Interviewee 2	Farmer producer and e-commerce retailer	Male	Founder	Sole proprietorship
Interviewee 3	E-commerce supplier company and retailer	Female	CFO	Start-up company
Interviewee 4	E-commerce retailer	Female	Founder	Sole proprietorship
Interviewee 5	E-commerce supplier company	Male	Co-founder	Partnership
Interviewee 6	E-commerce supplier company and retailer	Male	Buyer specialist	Start-up company
Interviewee 7	E-commerce retailer	Male	Operational manager	Partnership
Interviewee 8	E-commerce supplier company and retailer	Male	Founder	Sole proprietorship

The data analysis was facilitated by NVivo 12 QSR software for coding the data from interview transcripts. Six phases of thematic analysis were applied for classifying, analysing, defining and reporting the discovered themes (Braun & Clarke, 2006). The steps proposed by Braun and Clarke (2006) for thematic analysis consist of: (1) familiarising the data; (2) producing codes; (3) determining themes, (4) evaluating themes, (5) defining the names for the themes, and (6) writing the results. Thematic analysis was selected based on the offered flexibility of analysis and an advantageous method to examine the viewpoints of diverse research participants (Braun & Clarke, 2006). These advantages of thematic analysis were suitable for facilities the study objectives.

RESULTS

Customer-Needs Driven on Discovering the Online Food Purchase

The analysis shows the food e-commerce in Indonesia mostly operated in the urban area but dominated by small-medium enterprises (SMEs). The companies are ranging from start-up companies, partnership, family business or sole proprietorship. The online retailers attempt to accommodate consumer behaviour change towards food using the internet. The virtual food stores facilitated by instant messaging apps, social media apps, websites, mobile apps, or the combinations of electronic channel application. Although social media and instant messenger are the most common platform used to adjust customer lifestyle. The urban consumer lifestyle is considered to have higher preferences for online shopping. The two online platforms are recognised for its capability to make personal interaction and interactive communication with the targeted market.

The study showed that customer curiosity, customer buying behaviour change, customer food lifestyle changes and more demanding consumers underlying customer-needs driven. Customer curiosity on using online platforms to fulfil their needs drive as a source developing different relationships with customers compared to the conventional way with face-to-face interaction. The emerging virtual market has changed customer shopping habit and customer food lifestyle. Higher demand for food preferences become the drivers for SMEs based food e-commerce to discover more consumer needs and wants. The awareness of knowing customer characteristics and their readiness to conduct food buying via online channels are essential for marketing strategy and gain more potential customers.

The SMEs proactively respond to consumer needs by communicating the expected benefits of food purchase via online channels. It activates the role of customer as value co-creator through familiarising food shopping based-online channel and experiencing the food online channel usage. Developing customer engagement aims to propose distinctive food shopping experiences, such as more meaningful information shared in real-time, personal services offering, effectiveness and accessibility. The interview data reveal information regarding the benefits of food e-commerce existence in the food chains.

For this specific context of agri-food industry in Indonesia that dominated by SMEs along the supply chains, the electronic channels may provide benefits as well solutions for both business market and customers. Specifically, for customers, they may realise more benefits offered by food e-commerce to fulfil their needs and serve as competitive offerings. For example, it is providing one-stop-food store, shopping simplicity and social acquirement amongst urban society.

Customer Value Co-Creation Process through SMEs Based Food E-Commerce

The analysis reveals the process of engaging customers as part of value co-creation of food e-commerce. The process consists of (1) gaining customer attention; (2) role understanding; (3) interaction; (4) customer learning; (5) intervention; and (6) making consumers discover (see figure 1). The first stage of gaining customer attention is the initial phase of introducing the new food shopping platforms via online stores that significant to renew customer shopping habit. Promotions and provocations become essential at this stage to initiate customer awareness of food purchase via online channels. It conducted either via online promotions (e.g. social media, instant message broadcast) or conventional promotions (e.g. exhibitions, farmers market). The social interactions with the targeted market offer significant effects on customer engagement. The second stage of role understanding to make customer as co-creator in exploring the benefits of the channel may determine customer willingness to participate in the channels. Hence, the sellers perceived interaction development as an essential component to distribute messages to customers. Thus, the next stage of engaging customers is through interaction by providing access to the used online platforms, continues persuasion with customers, build interactive communication to avoid boredom and offered openness and transparency.

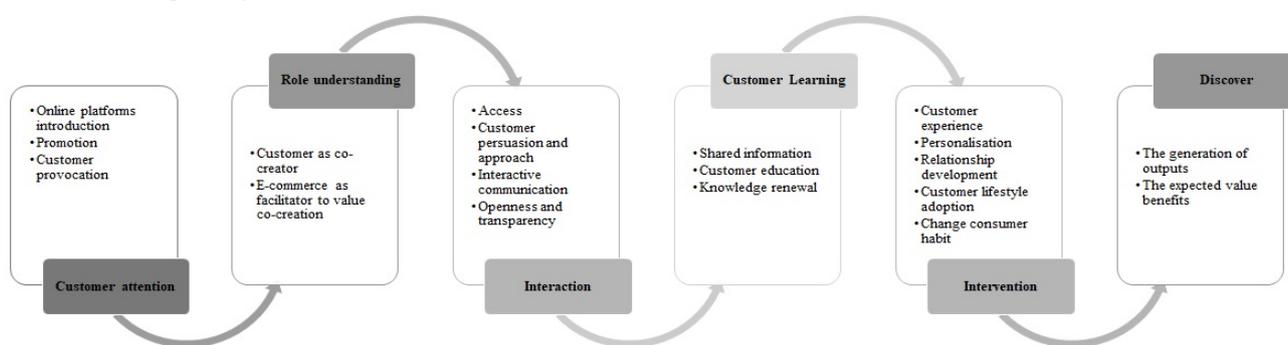


Figure 1. Customer engagement in the value co-creation process of SMEs based food e-commerce

Hereafter, the attachment with customers may lead them to have more access to learning what offered by food e-commerce. Customer learning facilitates customers to enhance the knowledge and at the same time to educate them on how to choose, to purchase and to consume foods advantageously. The learning process becomes crucial to renew customer knowledge on various food issues including food lifestyle. More meaningful insights provided by the sellers through the learning process may retain customers motivation to participate in the co-creation process. The next process on activating customer role in the co-creation is by sellers' intervention on optimising the benefits of using the online channels through online experiences, personalisation, relationship development, adoption to customer food lifestyle and generating a new food-related habit. The entire process end with making customer discover the co-creation benefits and outcomes. It may indicate as the success factor of keeping customer continue to develop long-term relationship with the business.

DISCUSSION

In this context, food issues (e.g. food safety, customer adjust food lifestyle, more information received by consumers) may change customer behaviour to buy food. Customer engagement can be considered as the pull factor to retain customers. By engaging customers, online retailers can explore a psychological journey that experiencing by consumers. Although the benefits experiencing by customers may vary depending on the roles taken by customers in the joint activities (Nambisan & Baron, 2009). Understanding how consumer experience with the buying process, the seller can identify and recognise how consumer developing relationships with the business. In this stage, the seller can interfere in the relationship development by connecting physically, cognitively and emotionally with customers. The sellers may offer problem solutions to customer's needs and wants in various ways including shaping the product and service experience. SME food e-commerce personalised customer experience by engaging customers throughout the value co-creation process to discover the overall benefits of utilising the online channels for food shopping.

The absence of awareness and understanding of customer engagement can be disadvantages for the company's ability to survive in the market. Specifically, when the customers are highly attached to the particular culture and lifestyle that may influence customer habits and attitude. Online customer experience, level of personalisation and relationship development become vital to engage with customers and activate their role to co-create more value by benefiting the online channel.

IMPLICATIONS

The transition stage of the retail revolution of SME-based food e-commerce in developing countries demonstrates a conceptual process of value co-creation while exploring the customer needs-driven to this specific context. Both scholars and practitioners

could learn from consumer behaviour changes displayed on online food purchase by managing each role and resources accordingly.

This study proposes theoretical implications to explore customer needs-driven to understand customer engagement in the value co-creation process on the employment of the online platforms for SMEs in the food industry. The study also tries to contribute to social exchange theory on the exchange relationships between customers and retailers in the online channels. As each actor relies on the responsibility realisation to receive the reciprocate benefits (Preikschas, Cabanelas, Rüdiger, & Lampón, 2017).

This study also proposes for practical contribution to discover and understand the role of customer needs-driven and customer engagement by using the online channels to buy foods beyond the traditional way. Knowing customer needs, wants and understanding their interaction with the food e-commerce and go online to purchase foods is critical to applies modes of engagement initiatives. It can also be a source of opportunities to collaborate with customers. Thru this pattern, the online retailer engages customers by communicating and selling various benefits instead of selling only the product features. By involving customers into business and asked them to participate in enhancing the expected benefits from the electronic business channel may turn this as a critical differentiator of SMEs food-based e-commerce.

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Just ticking the box: A social informatics model of the consequences of consent

(Work in Progress)

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ABSTRACT

Given the societal diffusion, proliferation and ubiquity of computerised systems and platforms, it is generally perceived by consumers that systems and eBusiness platforms often pose a threat to the privacy of their supplied information (Srnicek, 2017; Andreotti et al., 2018). Furthermore, as we see the replacement of systems that were once manual and paper-based migrate to digital processes and information systems (Lunt et al., 2019), consent in the information era is reduced to 'Yes' or 'No' option, often in the form of a tick box. Additionally, despite the arrival of the General Data Protection Regulation in 2018 as means to provide protection in relation to data processing, we argue that there is a lack of transparency in relation to the intention of this data processing and secondary data use for the purposes of research and marketing, for example. In light of this, we argue that there exists an increasingly difficult challenge to establish a mutual understanding of what consent actually is and what the wider permutations of it represents and comprehends. The lack of mutual understanding, in a digital world that is becoming increasingly reliant on the perceived benefits of acquiring and processing large sets of data (Kitchin, 2014; Breidbach et al., 2019) is deeply problematic. It is not only problematic for the consumer, but also to system developers, platform owners, and data processors alike.

To this end, this paper presents a model, derived from action research, which positions the concept of consent within a socio-technical framing. This model approaches consent, in the context of digital platforms and eBusiness and how it comes to be represented in information systems, as a socio-technical construct of moral orders that imbues the feelings, convictions and aspirations of the consumer as they are engaged in the use of digital systems. We offer that consent is merely approached as an attribute in a data model, rather than relaying the communicative understanding of the consumer. This model introduces the areas of information processing systems and information communication systems as two differing interpretations within which digital platforms can be perceived. We offer these two distinctions as a mechanism to explain and, more importantly, explore the notion of the governance of consent and how this comes to be manifested in information systems.

Keywords: Consent, data governance, information sharing, digital platforms

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INTRODUCTION

Information systems require inputs from its end users that often results in substantial economic, social or legal consequences (Böhme and Köpsell, 2010). In an attempt to explain what it is they are consenting to the consumer is often faced with verbose content containing line-after-line of general and vague terms and conditions lacking clarity (Esmaeilzadeh, 2019). Coiera and Clarke (2004) acknowledge that there is a challenge to ensure that the translation of legal rules designed to regulate human activity, when implemented in an electronic environment, does not have unexpected consequences. Indeed, the ability to implement an entire legal framework which is manifested so simplistically in a few lines of code in an information system is not the easiest of tasks. Despite suggestions by Friedman et al. (2005) to implement a Value Sensitive Design of consent within information systems, their approach is an aesthetic one, concerned with the HCI aspect of consent agreement within information systems and how this comes to be recorded. They continue (*ibid.*) that accounting for human values such as privacy, security and trust however are considerations of informed consent but are not dismissed due to ineptitude and habit (Böhme and Köpsell, 2010).

Take if you will the following scenario with the context of the subject matter of this paper: an application, deployed to and operated using a mobile device such as an iPad, is used by a practitioner to record their engagement with clients. The application records the information of the client and, in subscribing to data protection best practice, asks the client for their consent. The practitioner is confronted by a 'Yes' or 'No' option to confirm if the client provides their consent. The consent, it is inferred, is to confirm that the client agrees to accessing the service and that their data can be stored and processed. By clicking 'Yes' and accepting on behalf of the client, the practitioner also suggests that if the client had said no, it would have been difficult for further engagement and service delivery or intervention to continue.

By using this scenario, our paper asserts that we are concerned with exploring and providing a framing from which we are able to discuss the concept of consent that uses language associated with information *processing* and information *communication*. We do so to highlight that consent, whilst a communicative exchange of information, has been reduced to an instrumental

process of data processing. Our ambition is to provide, from a starting position, that consent should have an equal understanding for those that develop, interact with, and are subjects within, an information system application and that it cannot be merely trivialised to a human-computer interaction in the form of a tick box.

FRAMING THE NEED FOR CONSENT: MARY'S STORY

Applying McLoughlin and Wilson's (2013) fictitious but contextual aspect of care provision across a multitude of health and social care provision in which Mary, a 17-year-old, single mother who accesses local services that supports her and her child across a range of health, social, educational and other services. These other services, coupled with those that are publicly provided, include charitable organisations across a small geographical location. Within this locality, the 'wicked problem' of care provision for Mary and what information can be shared amongst care providers exists. To this extent, given the myriad of care providers involved with Mary, not one of them has a full picture or view (McLoughlin and Wilson, 2013) of Mary and her situation. To this extent, the sharing of information would allow for the correct identification and resolution of Mary's issues, however there is a pre-requisite to ensure that Mary has provided her consent to do so. It is at this point that there are larger concerns: not only is Mary unaware of what the implications of providing of consent are, but the manner in which this consent is recorded will not be reflective of her conversations with her care providers. The framing of the recording of consent – and indeed the consequences of the recording this in traditional measures – it one of the very issues we identify as a means to mode on facilitate the discussions to move discussions forward.

RECONCEPTUALISING THE INFORMATION PARADIGM

In order to explain our approach within this paper, it is first important to present our definitions of information systems, information processing, and information communications. At the most abstract level, we conceive an information system as a group of information objects which has the ability to store, transmit and transform said information objects. These information objects may be generated directly by "subjects" - which may be End Users or created automatically from sensors and measuring instruments. An information system, we suggest, is an attempt to represent - and therefore interpret - "real-world" entities, processes, and relationships. Typical information technology design and development processes conventionally undertake the task of translating, regulating, making any subsequent changes to information objects, and having them represented within an application (McLoughlin and Wilson, 2013). As such, we take this way of conceptualising information systems to be representative of an information processing paradigm. This paradigm adheres to a simplistic, two-part - or dyadic - relationship between information objects and the subject. At a very rudimentary level we represent this as follows in Figure 1:

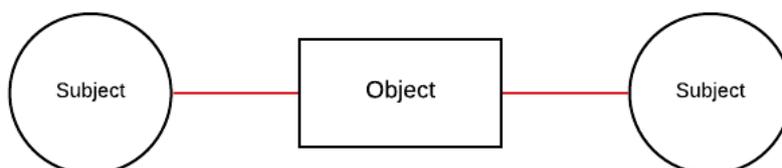


Figure 1: A representation of a dyadic information processing paradigm

As such, information systems are perceived as entities that make changes to information objects which are very-much transactional in their nature. They are defined in terms of pre-conditions, the transactional process itself, and a set of post-conditions. The purpose of the information system - as perceived through this paradigm - is, in effect, the recording of these transactions to provide a digital ledger and evidence of their occurrence and legitimacy. The dyadic perspective is, in essence, able to describe data transmission and its distribution in the traditional Shannon and Weaver (1963) perspective.

However, given we need to address the notion of consent beyond the simple transmission of information objects, there is a requirement to consider more than the transmission of information objects. As such, with regards to the subject of consent, we need to establish a clear distinction between the information objects that are processed and transported in various ways ("content") and the roles, norms, origins and intentions of the subjects who generate and interpret the information objects ("context"). This *triadic* – as opposed to the dyadic - representation makes explicit the exchange between subjects and also includes the relationship between both subjects and information objects. This also highlights the necessary requirement for the inclusion of context and content - and representation - within information systems. This is more apparent when discussing consent: we wish to establish not only that consent was given or withdrawn – that is information which is generated and exchanged within the information system ("content") but also under which perspective it was given and the purposes of its contents ("context"). To express this further, we provide the following representation in Figure 2, which highlights the extension of an information processing paradigm:

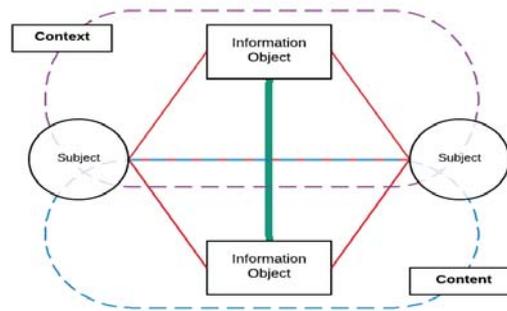


Figure 2: A representation of a triadic information communication paradigm

The impact, certainly from an information system perspective, suggests that content and context cannot be subsumed into a single data model. This single data model is often represented simply as a “Yes” or “No” and manifests itself, even in this era of data processing legislation, as a tick box across a plethora of information systems, digital or otherwise. As such, a remedial measure exists: to migrate beyond an information processing paradigm, *context* merely needs to become - as would be familiar to a data scientist, analyst, or database and systems developers - meta data of *content*. As a result, a shift toward an information communication paradigm allows for the inscription of relationally between subjects and the intentionality of their content. We therefore extend the paradigms of information processing and communication

REPRESENTING CONSENT IN THE CONTEXT OF INFORMATION PARADIGMS

As we have presented, the manner in which consent is conceptualised within information systems is in need of being addressed. In order to do so, we seek to understand how and why existing manifestations -namely the “Yes” or “No” representations of consent - have come to be implemented. To assist us, we look to Krippendorff (2009) and the approach to Ashby’s information theory. Applying this theory to the context of the construction and deployment of information systems allows for the consideration of the variety of informational views. These views help to determine as to how information is defined and therefore represented as a set of layers which is pertinent to those actors to that perceive it from their perspective. From this we suggest four views - or levels - as Record, Curate, Narrate and Instigate. We discuss these in detail in the following section.

Record View Of Information

With the Record view, we concern ourselves with the handling of chunks of data. Here, we talk about exactly where the data is and how and when it moves - this is where the mechanical processes of creating, storing, processing, transporting, and presenting chunks of data takes place. It is made up of tangible entities and its states, behaviours and transformations can be observed and recorded in systems logs; we are able to measure the quantity of information present in any situation and identify and fully characterise the medium within which it is being maintained or transported. However, the Record-level says nothing of the meaning of the data: the representation of values within a field of Excel spreadsheet, for example has no context. This view of information is, at its core, the detection, measurement and record of concrete events.

Curate View of Information

At this view, we represent all our data models, terminologies, message and document standards and are concerned with codes and their denotations - for example, the codification of whether consent was given or not as translation of ‘yes’ or ‘no’. At the ‘Curate’ view, consent is an attribute within a data model, i.e. the value of a data item on the basis of which functions can be allowed or prevented at the recorded level, for example, to grant or withhold the access of a particular user to a particular set of data to a particular user on a specific occasion. The consent attribute must be attached to an entity represented in a data model. This could be the identity of the consenter in the role of patient implying that the consent is global to all of that individual’s data, it could be attached to certain classes of data. In this case the granularity and discrimination depend on the classification scheme that is implemented at the Recorded view.

Narrate View of Information

Here we consider the roles and responsibilities which form the contexts in which information is generated and, ultimately, interpreted. In this view, we specify and record the norms and expectations associated with the roles and relationships we intend to mandate and support. Also, at this view, a consenting individual is assuming or accepting a role which involves a set of accountabilities and responsibilities in relation to other roles and a set of rights or duties. Role and right of duties are with respect to certain instruments such as a statement of consent. At this level we must consider the conversational mesh which includes the practitioner who has the duty to inform and the instruments we take to be appropriate vehicles for the information which is the content associated with being informed, the empowered party who can act on the basis of the consent, and a number of other parties.

Instigate View of Information

At the Instigate view of information, this encompasses identity, value and principles and shared significations where meanings come to be accepted. At this view, we consider the experience of those from the inside, as a participant within the system but also consider the imposition of policy, law and culture.

To aid with the representation of the views of information, we provide the following in Figure 3 to illustrate this alongside their definitions:

View of information	Definitions of information
Instigate	Individual and collective identities, values and principles
Narrate	Roles, relationships and responsibilities
Curate	Codes, terms and entities
Record	Values and records

Figure 3: Views and definitions of information (adapted from Krippendorff, 2009)

Furthermore, in order to frame our previous conversation regarding the information processing and information communication paradigms, we suggest that information in relation to consent is viewed at a Record and Curate-level, when in actuality it should be viewed at a Narrate and Curate-level. Given that we have access to language, categorisations, information objects and subjects, these are collapsed and represented within the Curate and Record views as a representation of mandates and acceptability. The following in Figure 4 illustrates how we understand the views and definitions of information encompass each information paradigm:

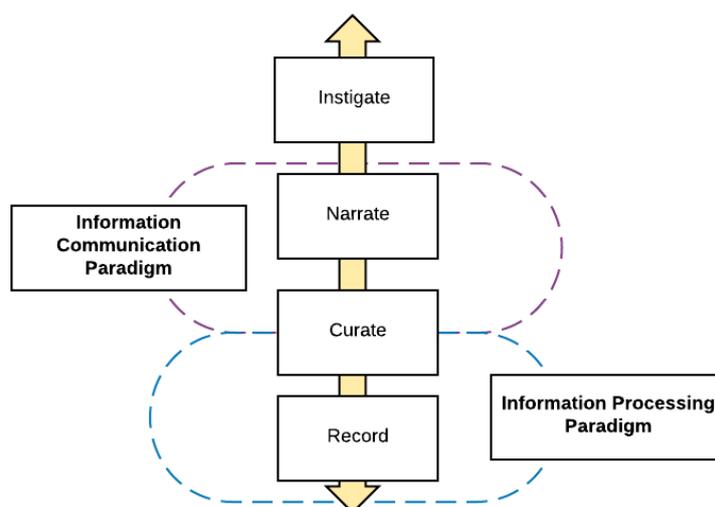


Figure 4 - Views and definitions of information (adapted from Krippendorff, 2009) within the context of information processing and information communication paradigms

We believe that the representation of this model provokes further the understanding and concepts of contentious subjects such as consent. Given this, should we apply the concept of an information communication paradigm to consent, the instruments of consent - the individual's ability to grant or withdraw consent - commence with the narrative setting within which they are provided. This is in contrast to where consent is usually reduced to the Record view of information. The impact of which is

that, as we have discussed, is that consent and its onward impact and consideration are merely treated as a data field and limited to a Record and Curate view of information which then reduces the ability to explore consent – grant or otherwise – is correctly communicated to those that are end users of an information system. We are not attempting to develop an approach here that is dismissive of the Record and Curate views of information (the information processing paradigm) as these views are what are needed to ensure that an information system is, and remains, a manageable artefact. Indeed, what we are trying to provide here is the notion of governance, one that confirms intentionality, (“Did we intended for this to happen? Is this what we intended?”) of the information system.

CONCLUSION

Within this paper we have applied a critique to the use of the conventional paradigmatic perspective on information systems and how this is applied to the notion of consent. In response to this, we have provided an alternative approach based upon which we refer to as the information communications paradigm alongside an initial, theoretical framing. Within this discussion we have identified a number of factors associated with considerations of consent when applied within information systems, and how the use of an information communication systems and an associated paradigm is required in order to support the accurate recording of the conversations regarding consent. Whilst the application here is somewhat limited, it warrants further research and application in order to improve further the discussions regarding consent and how they are framed - currently and incorrectly - within the information processing paradigm. We believe the discussions of consent within the context of an information communication paradigm has equal benefit to the end user, the information system owner, and the information system developer.

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Sentiment Analysis of Tourism Reviews: An exploratory study based on CNNs built on LSTM model

(Work in Progress)

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ABSTRACT

This study is to develop a sentiment analysis system for customers' review on a scenic site. It is based on Convolutional Neural Networks (CNNs) built on Long Short-Term Memory (LSTM) models for text feature extraction under a deep learning framework. The CNNs built on LSTM models applies convolutional filters of CNNs repeatedly operate on the output matrix of LSTM to obtain robust text feature vector. In this study, the optimal parameter configurations for each component of CNNs and LSTM are given individually in the first place. Then, the entire optimal parameter configuration for the integration recognition frame of the system is identified around the optimum of each component. The results demonstrate that, by employing such a method, the accuracy for sentiment analysis with CNNs built on LSTM model, compared with a single CNNs or LSTM model, is improved by 3.13% and 1.71% respectively.

Key words: sentiment analysis, CNNs, LSTM, Classification

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INTRODUCTION

Tourist's review on a scenic site contains marketing information, feedback to services and customer's sentiment, which is critical to improve the management of the scenic spot by means of designing more effective operating pattern. Sentiment analysis of tourist' review is an integration of natural language processing and machine learning. Different to English segmented on spaces, the Chinese text needs a tokenizer such as Jieba and ICTCLAS etc to convert it into a sequence of words.

The word embeddings that maps words or phrases to vectors of real numbers is widely used to capture meaningful syntactic and semantic regularities helps learning algorithms to achieve better performance in natural language processing tasks by grouping similar words. As for representation of the text as fixed-length feature vector, the bag-of-words (BOW) and skip-gram are first employed to obtain acceptable accuracy (Mikolov, et al. 2013). By keeping the context information, deep learning techniques have significantly outperformed traditional methods. Two of the most popular deep learning techniques for sentiment analysis are Convolutional Neural Networks (CNNs) and Long Short-Term Memory (LSTM) (Grefenstette, et al. 2013; Zhang, et al. 2017)

The CNNs only extract the local features, while LSTMs are a type of network that has a memory that remembers previous data from the input and makes decisions based on that knowledge. Therefore, LSTMs are more directly suited for text inputs, since each word in a sentence has meaning based on the surrounding words. Since, this research developed a sentiment analysis system for customers' comments based on LSTM-CNN model to extract text feature vector. In other words, the LSTM layer is generating a new encoding for the original input. The output of the LSTM layer is then fed into a convolution neural network layer which we expect will extract local features for sentiment classification.

SYSTEM DIAGRAM

To realize sentiment analysis of comments, the comments text is first preprocessed by Jieba to segment the comment string into corresponding word sequences. Then, each word of the tokenized comment text is mapped into d -dimensional word embedding by Word2Vector. Next, the text feature of comment is selected by LSTM, CNN or CNN built on LSTM. Last, the sentiment classifier based on neural network is used to realize the sentiment analysis of comment. It is necessary to address that the last two steps can work in deep learning frame. The left of figure 1 describes the dataflow of the system and the right gives out the corresponding modules.

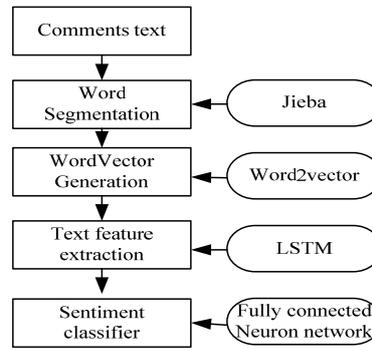


Figure 1: Dataflow of sentiment analysis system.

TEXT FEATURE EXTRACTION

Suppose there is a tokenized text sequence composed of n tokens (words), noted as $t(w_1, w_2, \dots, w_n)$. Each token $w_i (1 \leq i \leq n)$ is represented by a d -dimensional word embedding trained by word2vec or GloVe models. Thus the text t is converted to a text matrix A with dimensionality $n \times d$. The columns of text matrix are tokens sequence, and the rows are word embedding of each token.

Based On LSTM

A layer with multiple LSTM units works as the feature extraction layer in the network, and the input of each unit corresponds to the tokens of sequence text (Tang, Duyu, et al. 2016). An LSTM unit is a memory cell composed of four main components: an input gate, a self-recurrent connection, a forget gate and an output gate. The forget gate determines how much previous context information h_{t-1} and current input information x_t are discarded via the value of factor f_t , 0 indicates overall discarded, 1 does overall remained, which is computed by formula (1). An input gate controls the effect to current memory cell i_t , according to the previous state h_{t-1} and the current state x_t , computed by formula (2). Then, generate candidate vector \tilde{C}_t , computed by formula (3), to update the current memory cell. The new state is computed by formula (4). The output gate factor computed by formula (5) allows how much information h_t to next memory cells, computed by formula (6). The output h_n of last LSTM unit is the obtained text feature vector with the same dimensionality with word embedding.

$$f_t = \sigma(w_f \cdot [h_{t-1}, x_t] + b_f) \quad (1)$$

$$i_t = \sigma(w_i \cdot [h_{t-1}, x_t] + b_i) \quad (2)$$

$$\tilde{C}_t = \tanh(w_c \cdot [h_{t-1}, x_t] + b_c) \quad (3)$$

$$C_t = f_t * C_{t-1} + i_t * \tilde{C}_t \quad (4)$$

$$O_t = \sigma(w_o \cdot [h_{t-1}, x_t] + b_o) \quad (5)$$

$$h_t = O_t * \tanh(C_t) \quad (6)$$

Based On CNN

The text matrix is denoted by A with dimensionality $n \times d$, and $A[p:q]$ represents the sub-matrix of A from row p to q . Supposed there are a series of filter matrix $w_i (1 \leq i \leq m)$ with filter window $h_i \times d$. The output sequence $O_i (1 \leq i \leq n - h_i + 1)$ of the convolution operation is obtained by repeatedly applying the filter w_i on sub-matrices of text matrix A , computed by formula (7), where $k = 1, \dots, n - h_i + 1$, and \cdot is the dot product between the sub-matrix and the filter. A bias term b is added to each O_i , then activated by function f to obtain the feature map $C_i (1 \leq i \leq n - h_i + 1)$ for filter w_i , computed by formula (8). The dimensionality of each feature map C_i will vary as a function of the text length and the filter window size. To obtain a fixed-length feature vector, k-max pooling function is applied to each feature map C_i to extract $k (k \geq 1)$ scalars. Then, all scalars extracted from each feature map are concatenated into a fixed-length text feature vector (Lakshmi, et al. 2017; Yoon Kim, 2004)

$$O_i = w_i \cdot A[k:k+h_i-1] \quad (7)$$

$$C_i = f(O_i + b) \quad (8)$$

Based On CNN Built On LSTM

In above Section A and Section B, the text feature vector is only extracted by LSTM or CNN separately. In this section, we resort to a CNN structure built on the outputs of LSTM to obtain a more robust text feature vector, as shown in figure 2. The structure of CNN and LSTM in the figure are similar to the one depicted in above two section. In the CNN built on LSTM approach to text feature extraction, the text matrix A first passes through the LSTM layer to obtain the corresponding output of LSTM $h(h_1, h_2, \dots, h_n)$. Since each output of LSTM unit $h_i (1 \leq i \leq n)$ is same d -dimensional vector with each token, the output of LSTM can also be transferred into $n \times d$ matrix, noted as H . Similar with text feature extraction based on CNNs, the CNNs built on LSTM approach operates on the output matrix of LSTM H to obtain the text feature vector.

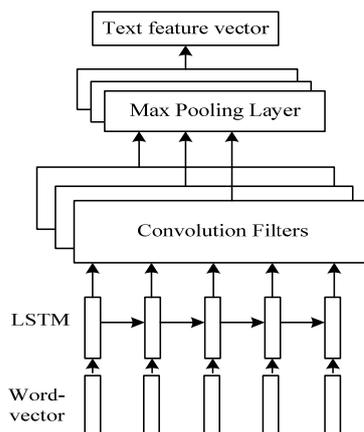


Figure 2: Text feature extraction based on CNN built on LSTM.

CORPUS AND DATABASE

To obtain the large enough corpuses for word embedding training, two steps were taken by the researcher: origin text extraction from the Wiki dump on 20th November, 2018 and conversion of extracted origin from traditional Chinese to simple Chinese to build the corpus database, noted as CCDatabase. This resulted in a larger database, which includes 14,327 Chinese character categories, in total 1.38GB.

SSC database, as tourist comments database that is collected by a research group of tourism big data under Inspur Company, is employed in this research. This database contains 1,000,000 comments labeled as three classes, positive, neuter and negative denoted as 1, 2 and 3 respectively. The length of comments is variable from zero to 536 Chinese characters, common in 35 to 155 Chinese characters. The average length of comments is about 76 Chinese characters.

EXPERIMENTS AND ANALYSIS

In this paper, all experiments are conducted under the base recognition frame, composed of Chinese word tokenizer, word embedding, text feature extraction and classifier four components. Moreover, to reduce over-fitting, the dropout layer is succeeded after text feature extraction layer. The dataflow of base recognition frame is depicted in section 2, and the configuration of each component is shown in table 1. To study the effect of different components with different parameter settings, we hold all other settings constant and vary only the interested component. For every configuration that we consider, we employ 5-fold cross validation and only report the mean of 5-fold cross validation.

Table 1: Overview of base recognition frame.

Description	Values
Word tokenizer	Jieba
Word embedding	Google Word2vec
Text feature extraction	LSTM, CNNs or LSTM+CNNs
Drop rate	0.5
Classifier	Two-layer Neural Network

Text Feature Extraction With LSTMs

The word embedding is semantic representation of input word in lower dimension. Thus, dimensionality (d) of word embedding is key factor for a nice property of text sentiment analysis. Moreover, the performance of LSTM is dependent on the size of context window. Therefore, we first explore the sensitivity of sentiment analysis system based on LSTM with different dimensions of word embedding and different sizes of word context window.

Word embedding in all applications, the dimensionality of word embedding with the range from 160 to 300 has been commonly used. In our system, we consider variations from 160 to 240 with the step 20. For each dimension, we take a different size of context window (k) from 20 to 100 with the step 20 so that we produce 25 different configuration settings. We measure the accuracy of the system for the 25 different parameter settings as shown in Table 2. From the table, the parameter setting $d=200$ and $k=80$ contributes the best recognition accuracy which is bold.

Table 2: The accuracies of the system with different d and k .

d/k	20	40	60	80	100
160	79.52	79.92	80.87	81.52	81.43
180	80.18	81.23	81.63	82.13	82.07
200	80.27	81.34	81.92	82.85	82.71
220	80.31	81.39	81.87	82.72	82.68
240	80.24	81.27	81.71	82.55	82.53

Text Feature Extraction With CNNs

To evaluate the effect of text feature extraction based on CNNs to text sentiment analysis, we explore the different parameters configurations of CNNs with the other components of base recognition frame constant. The discriminating performance of text feature extraction with CNNs is dependent on the number of the convolutional filters and k -max pooling schema.

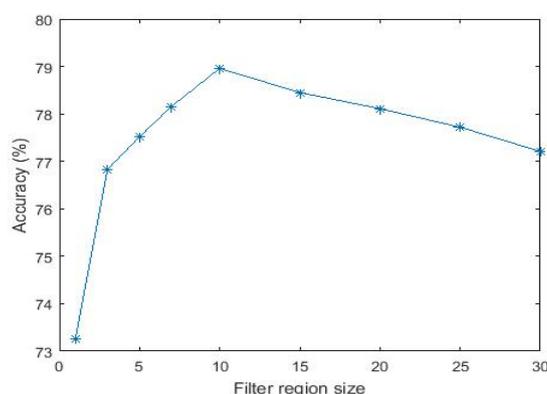


Figure 3: Accuracy trends with single different filter region sizes setting.

Since the dimensionality of word embedding with 200 obtains the best recognition accuracy in table 2, keep the dimensionality of word representation with 200 constant to focus on the comparison of other parameters setting. Once the dimensionality is specified, the size of filter region only relies on its height. We first explore the effect of single filter region size and set the number of feature maps for this region size to 100 (as in the baseline configuration). We consider filter region sizes of 1, 3, 5, 7, 10, 15, 20, 25 and 30, and report results as shown in figure 3.

We also explored the effect of combining different filter region sizes, while keeping the number of feature maps for each region size with 100. From the figure 3, we can observe that the optimal single region size is 13. In light of combining several region sizes close to the optimal single region size can improve performance, but adding region sizes far from the optimal value may hurt performance. Therefore, we explore the combination of several region sizes nearby this single best size 13, including combining both different region sizes (12, 13), (12, 13, 14), (12, 13, 14, 15) and (10, 11, 12, 13) and copies of the optimal sizes (13, 13), (13, 13, 13) and (13, 13, 13, 13). The results are reported in table 3.

Table 3: Accuracy of filter regions with several region sizes.

Multiple region size	Accuracy (%)
(12, 13)	82.23
(12, 13, 14)	82.73
(12, 13, 14, 15)	82.51
(11, 12, 13, 14, 15)	82.51
(10, 11, 12, 13)	82.45
(13, 13)	81.26
(13, 13, 13)	81.35
(13, 13, 13, 13)	81.34

As for the pooling strategy, we prefer k -max pooling strategy rather than average strategy. The k -max pooling strategy extracts top-level k scalars from each feature map to together generate text feature vector. We explored the k from 1 to 10 when the number of feature map is set to 100 and the single region size is set to 13. The results are shown in figure 4 and we found 1-max pooling fared best. The $k > 1$ does not show any obvious improvement in our early experiments.

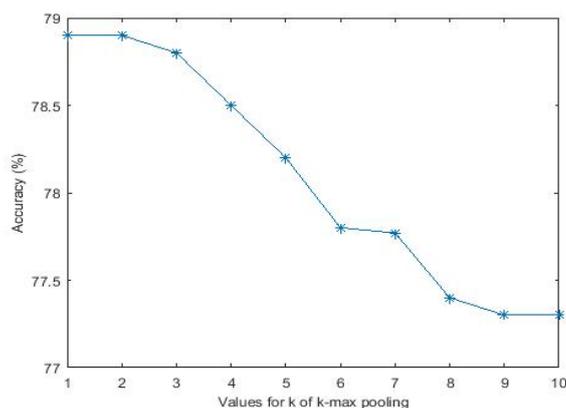


Figure 4: Accuracy trends with different k for k -max pooling.

The combining filter size (12, 13, 14) and 1-max pooling setting obtained optimal text recognition accuracy as shown in table 3 and figure 4, respectively. We again hold these optimal configurations constant within the base recognition frame, and change only the number of feature maps taking 10, 50, 100, 150, 200, 300, 400, 500, 600 and 700. The result is reported in figure 5.

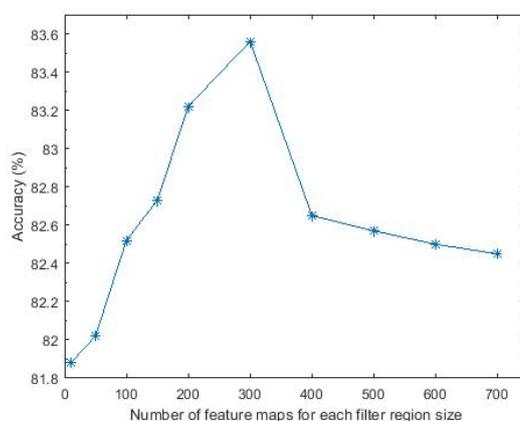


Figure 5: Accuracy trends with different number of feature map for each region size.

Text Feature Extraction With CNNs Built On LSTM

The section 4.B illustrated the parameters configuration with 1-max pooling, multiple filter size (12, 13, 14,) and the number of feature map setting to 300 for each filter region size achieves optimal result for sentiment analysis based on CNNs. So, we hold the optimal parameter configuration of CNNs invariable and search optimal configuration of LSTM parameters around the optimal parameter settings of separate LSTM, dimensionality of word embedding 200 and size of word context 80, as reported in section 4.A. We consider variation of word embedding dimension from 180 to 230 with step 10, and each dimension takes a group of context windows with size from 70 to 100 stepped by 5. The results are reported in Table 4.

Table 4: The accuracies of text sentiment analysis.

d/m	70	75	80	85	90	95	100
180	80.23	81.19	81.82	82.56	82.61	82.48	82.27
190	80.97	81.67	82.03	82.92	82.83	82.71	82.37
200	81.33	81.79	82.62	83.11	82.96	82.80	82.65
210	81.36	81.63	82.71	82.96	83.05	82.91	82.74
220	81.29	81.42	82.35	82.84	82.93	82.65	82.49
230	81.18	81.31	81.96	82.23	82.67	82.53	82.31

Similarly, we also keep the best parameters setting with dimensionality of word embedding 200 and size of word context window 85 illustrated in table 2 constant to find best parameter setting for number of feature map and size of filter region of CNNs in CNNs built on LSTM feature extraction approach with 1-max pooling. Based on above experimental results of separate CNNs for feature extraction in section 4.B, we first search the optimal filter region size around best multiple sizes (12, 13, 14) and best single size 13 with the number of feature map setting to 300 for each filter size. The results are reported in table 5.

We further set optimal filter region sizes as (11, 12, 13) as shown in table 5 to find optimal number of feature map for each filter size around 300. We consider the variation from 250 to 350 with step 20, then, find the best number of feature map configuration with 290 to obtain the best sentiment analysis accuracy 83.82%, as illustrated in figure 5.

Table 5: Accuracies of CNNs built on LSTM with different filter region size setting.

Single size	Accuracy (%)	Multiple region size	Accuracy (%)
10	80.42	(10, 11, 12)	83.18
11	80.56	(11, 12, 13)	83.56
12	80.83	(12,13, 14)	83.26
13	80.21	(10, 11, 12, 13)	83.12
14	80.18	(11, 12, 13, 14,)	83.08
15	79.88	(10, 11, 12, 13, 14)	82.89

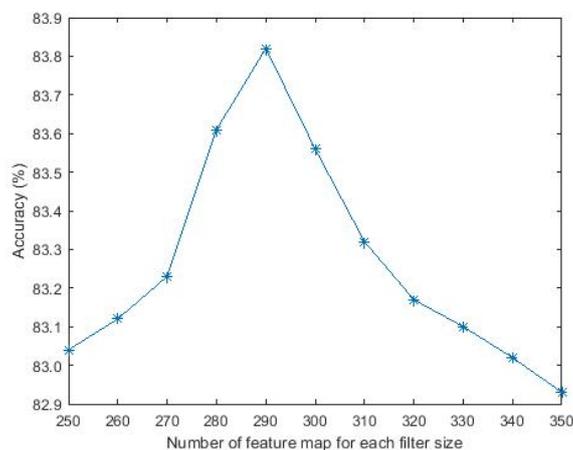


Figure 5: Accuracy trend with different number of feature map for each filter region size.

Experimental results demonstrate that the accuracy for sentiment analysis with CNNs built on LSTM model improved by 3.13% and 1.71% respectively, compared with separate CNNs and LSTM model.

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The Dynamics of Funding Behaviors in Reward-Based Crowdfunding Projects

(Work in Progress)

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ABSTRACT

With the growing popularity of crowd-funded markets, smaller manufactories and entrepreneurs are regarding crowdfunding as their main venue of financing. To better understand the dynamic behaviors of participants (i.e. backers) and supplement existing works in crowdfunding research, the paper studies how early backers' funding decisions influence the later participants in a special reward-based crowdfunding projects. By using vector autoregressive models, we plan to find empirical evidence for the existence of herding and bystander effects in our research context while controlling for strong signals of founders' quality. With this research-in-progress, preliminary results and discussion are provided.

Keywords: Crowdfunding, reward-based, herding effect, bystander effect, vector autoregressive models

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INTRODUCTION

Over the past decade, many companies, entrepreneurs and charity organizations have been using crowd-funded markets as one of their main sources for fundraising, leading to an explosive attention from academia to crowdfunding platforms. Early works in the area studied factors influencing the success of crowdfunding projects, such as interface element designs (Beier & Wagner, 2015; Simons, Weinmann, Tietz, & vom Brocke, 2017; Tietz, Simons, Weinmann, & vom Brocke, 2016), the language of project descriptions (Kim, Cho, & Lee, 2016; Mitra & Gilbert, 2014; Xu et al., 2014), and founders' characteristics (Hou, Wang, & Ge, 2015; Lin & Viswanathan, 2015).

More recent work have shown strong interests in the funding dynamics of participants (i.e. funders or backers), particularly, how early contributions influence the subsequent backers' behaviors. However, many of them study the issue for charity projects (Burtch, Ghose, & Wattal, 2013; Solomon, Ma, & Wash, 2015), leaving backer behaviors for reward-based projects less investigated despite its popularity (Mollick, 2014).

Behaviors for charity-based projects and for reward-based projects could be very different. For the former, backers perceive themselves as contributing towards a greater social good (Aitamurto, 2011; Solomon et al., 2015) and the projects involve backers' altruistic motivation. However, founders of reward-based projects often use crowdfunding to raise capitals for start-ups or finance their creative ideas (Roma, Gal-Or, & Chen, 2018). Hence reward-based projects motivate backers with tangible, non-financial rewards or pre-purchasing opportunities. For such projects, to understand when and how backers decide to fund their projects is vitally important to adjust their attempts in posting innovative products.

To study the dynamics of pledge performances, we collected data of crowdfunding projects from a very special platform called iZhongchou, which is affiliated to Taobao.com, a well-known B2C online market. The platform is unique in a way that project founders are all required to be good sellers on Taobao. With the existing signals on Taobao, backers' behaviors in such crowdfunding projects may show special patterns comparing to those on other platforms.

Our data collection is not only on crowdfunding projects but also on founders' shop performance on Taobao. Together, the dataset contains 2,421 weekly observations for 470 projects during Sep 2017 to May 2018. By using vector autoregressive models with exogenous covariates (VARX), we plan to estimate the long-term and accumulative effects of prior backers' behaviors.

Findings of the work could bring insights to both research and practices. The funding dynamics on the special platform joins the literature on online marketing and sheds light upon studies in entrepreneur innovation. The paper can also provide strategies for founders on the platform to adjust or manage their crowdfunding campaigns so that they be most benefited from the campaigns.

RELATED LITERATURE

Funding behaviors in crowdfunding projects

Studies on the funding behaviors in crowdfunding are many. Some of them focuses on the design of projects or funding platforms to investigate their impact on the project success and funding behaviors. For example, Roma et al. (2018) studies how the design of projects influence the subsequent VC funding behaviors. Chakraborty and Swinney (2019) focused on the funding target and found that founders should signal high quality to investors by setting a high target. Bi, Geng, and Liu (2019) investigates the differences in fixed and flexible funding mechanisms and provides pledging strategies for both backers and prediction for founders.

There are also studies working on the dynamics of backers' funding behaviors. Among them, two specific funding periods particularly stand out in existing works – early stage of the entire funding period, and the threshold timing of achieving the funding goal. Colombo, Franzoni, and Rossi-Lamastra (2015) investigates one of the determinants for early pledges – internal social capital. They also find a positive relationship between early pledges and the project success. Crosetto and Regner (2018) further examine the situations when projects lack early pledges and find projects' communication plays an important role in projects' final success. For the goal-reaching timing, Li and Wang (2019) find special patterns in the backers' pledging and sharing behaviors for both public-good and private-good projects.

Dynamics in contribution behaviors

Regarding how early contributions influence later contribution behaviors, papers studying different crowdfunding projects conclude with different findings.

Herding effect has been found in projects for equity-, lending- and charity-based crowdfunding (Agrawal, Catalini, & Goldfarb, 2011; Herzenstein, Dholakia, & Andrews, 2011; Zhang & Liu, 2012). The theoretical support of herding behaviors is rooted in signaling theory – early contributions, acting as quality signals, trigger the subsequent contribution behaviors (Burtch et al., 2013; Zhang & Liu, 2012). Additionally, rational herding behaviors are found in crowd-lending markets that backers observe early contributions and use observable founder features to moderate their inferences (Zhang & Liu, 2012).

Another opposing phenomenon is the bystander effect, i.e. potential backers decide not to contribute as the project has already been receiving a great deal of support (Kuppuswamy & Bayus, 2017) and they feel less important of their own contributions (Burtch et al., 2013). The bystander effect (also crowd-out effect) has been documented in charity-based (Burtch et al., 2013) and reward-based crowdfunding projects (Kuppuswamy & Bayus, 2017). And the focuses of the two papers are the amount of monetary contribution and number of funders respectively.

STUDY CONTEXT & METHOD

Our study context is iZhongchou, a crowdfunding platform affiliated to Taobao.com, which is one of the biggest e-commerce platforms in China. The platform is specialized on reward-based crowdfunding campaigns. iZhongchou follows the dominant approach of crowdfunding, the “all for nothing” model, which means that the collected money is only given to the project initiator if the target fund of the campaign is achieved within the campaign duration.

Project founders on the platform are unique. Regulated by the iZhongchou, project founders must have opened their shops on Taobao.com already and performed well in their past transaction history. Therefore, the founders have already signaled their quality through the performance in the Taobao shops.

The projects we targeted on are from two categories, Technology and Design, which are typically more risky and require large amount of capital (Hogg, 2014; Roma et al., 2018). Founders of such projects normally use the crowdfunding to pre-sell their innovative products and assess the market potential (Crosetto & Regner, 2018).

To test the existence of herding or bystander effect, we constructed a dataset by weekly crawling and collecting data from iZhongchou. Our dataset contains project records collected during September 6th 2017 – May 2nd 2018 in the two categories. In total, there are records for more than 500 projects. We further filtered them, keeping those that started and ended within our collection window.

After processing, we have 2,421 project-week observations for 470 distinct projects, among which 18 projects were not funded successfully (the funding goal were not reached when the project ended). The projects duration vary from one to eight weeks.

Besides, in our data collection, we were able to collect information on founders experience in funding the projects. The 470 projects in our dataset were conducted by 303 distinct founders. There were 230 out of 470 projects were founders' first attempts during our collection period, while 240 projects were founders' further attempts.

Measurements

A list of all variables included in the VARX models is provided in Table 1. Our focal variables are the funding status of a project i at time t , including *Raised funding*, measured by the ratio of the current funding over the funding goal, and *Number of funders*,

measured by the current number of accounts contributing to the project. Noted that following the all-or-nothing model, a project succeeds when *Raised funding* reaches or high than 1. If a project yields a *Raised funding* lower than 1 when the campaign ends, the project is unsuccessful.

We control the length of project description and the minimum price of the project’s reward choices. Particularly, on iZhongchou platform, description of all projects are delivered with images. Therefore, the description length is the summation of images’ length (in pixels).

Table 1: Descriptive Statistics of Variables

Variable	Mean	Std.dev.	Max	Min
RaisedFunding	4.365226	7.344317	0	95.03399
NumberofFunders	3267.019	7624.671	0	111423
DesLength	21709.15	10584.9	1161	87024
MinPrice	296.2028	531.713	0.1	3599
Score	4.880837	0.1320316	4.4	5
Size	56.96575	522.2116	1	12647
Sales	7620.204	49988.11	1	689184

To account for other founder signals such as credibility and experience in e-commerce, we control for the founders’ shop *Score* (average review rating from previous buyers), *Size* (number of products being posted in its own shop), and its *Sales* data (number of previous orders).

Model specification

The following VARX model is built:

$$Y_t = \mu + \sum_{j=1}^q A_j Y_{t-j} + BX + \varepsilon_t$$

where *t* represents time, *j* is lag length and the *q* is maximum lags. The lag order is selected by Bayesian information criterion (BIC), Akaike information criterion (AIC), and the Quinn information criterion (QIC). The optimal lag order was two according to the criterions. $Y_t = (RaisedFunding, NumberofFunders, DesLength, MinPrice)^T$, $X_t = (Score, Size, Sales)^T$.

PRELIMINARY RESULTS

To check of collinearity and multicollinearity exist, we analyzed the correlation and variance inflation factor (VIF). The mean VIF did not exceed 1.02. We conclude that no such issues exist in our data given the low correlation value (as shown in Table 2) and the VIF value.

Table 2: Correlation Matrix

	1	2	3	4	5	6	7
1. RaisedFunding	1						
2. NumberofFunders	0.5455	1					
3. DesLength	-0.0271	-0.0206	1				
4. MinPrice	0.0028	-0.0339	0.047	1			
5. Score	-0.0072	0.0051	-0.0681	-0.0509	1		
6. Size	-0.0049	-0.0141	0.074	0.0528	-0.0915	1	
7. Sales	-0.1903	-0.0411	0.0337	0.0036	-0.0088	0.0826	1

To run the VARX model, we first check whether the variables were evolving stationary by conducting unit-root test using an augmented Dickey-Fuller test with 1 lags. The result rejected the null hypothesis of a unit root with a 95% confidence level.

We run Hausman test to determine the existence of fixed or random effect in our panel, and find the presence of fixed effect in both of our focal variables. Therefore, correlation issues between variables might occur. Overcome its influence, the VARX is estimated by the Generalized Method of Moments (GMM), with the lags of the regressors as instrumental variables (Holtz-Eakin, Newey, & Rosen, 1988).

Exogenous variables

As shown in Table 3, the quality scores of the shops are negatively associated with description lengths of the crowdfunding projects, indicating that quality sellers on Taobao are not paying as much efforts as others would do in marketing their projects. Also, the past sales of founders' shops have a negative relationship with the RaisedFunding. The counter-intuitive results might be caused by two reasons, one is the rational herding behaviors previously found in microloan markets (Zhang & Liu, 2012), i.e. people uses the observable variables to make inferences; the other possible reason is on the founders' side – their less attention on the crowdfunding projects may also cause the effect.

Table 3: Coefficients of Exogenous Variables

Variables	RaisedFunding	NumberofFunders	DesLength	MinPrice
Score	-6.835 (-0.46)	-5101.163 (-0.54)	-58847.28 (-2.09) **	115.275 (1.63)
Size	0.00046 (0.69)	0.244 (0.52)	1.979 (1.59)	-0.005 (-1.72) *
Sales	-0.00037(-2.44) **	-0.577 (-1.57)	-0.572 (-1.38)	0.00008 (0.07)

Note: Coefficients and t-values (in parenthesis) are reported in the table. ** and * denote statistical significance of 5% and 10% level.

Further analyses

We plan to conduct Granger Causality tests (Abrigo & Love, 2016; Granger, 1969) to understand the (granger) causality direction of our focal relationships. We will further compute the impulse response functions (IRFs) for better interpretation of the results. The IRF exhibits a variable's behavior faced with a shock in another variable. The function also helps to understand the time needed for variables to go back to equilibrium after shock.

For robustness checks, additional VARX models for each project categories will be tested to assess the consistency of the results. Other adjustment of the model and plan for further analysis are introduced in the Discussion section below.

DISCUSSION

With the growing popularity of crowd-funded markets, smaller manufactories and entrepreneurs are regarding crowdfunding as their main venue of financing. Our work joins the discussion of backers' funding dynamics by conducting analysis on the special crowdfunding platform affiliated to a well-known online market. The finding of the work could help understand the backers' behavior and provide strategies for project founders to manage their projects, by which the work may contribute to current studies of both online marketing and entrepreneur innovation.

The current work has a few limitations. First, the current VARX model does not consider the effect of the reward design. According to prior studies (Chakraborty & Swinney, 2019; Roma et al., 2018), the design might influence backers contribution decisions at the early stage of the funding period. Second, our model does not account for further analysis on the current performance of exogenous variables. We plan to look deeper into the above issues and adjust our models accordingly. In addition, we do not investigate the potential impact of crowdfunding success on the performance of Taobao shops in future, for which later research may wish to investigate empirically.

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Understanding the Turnover Intention of Crowd Workers of Microtask Crowdsourcing Platform

(*Work in Progress*)

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ABSTRACT

Microtask crowdsourcing is a relatively new work form enabled by information technologies. For both practitioners and academics, understanding the turnover intention of the users, requesters and crowd workers respectively, of microtask crowdsourcing is very important. However, compared with the relatively large literature on requester, studies focusing on worker crowd workers are limited. Therefore, in this study, we investigate the crowd workers' intentions to leave the microtask crowdsourcing. The research goal is to analyze the motivations of crowd workers systematically and identify those factors that influenced their turnover intention. Based on perceived value and justice perspectives, a research model is developed. The proposed hypotheses will be tested using data from Amazon Mechanical Turk.

Keywords: crowdsourcing, turnover intention, perceived value, perceived justice, satisfaction.

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INTRODUCTION

The development of information and communication technologies (ICT) has not only changed people's daily lives but also the way how they work. *Crowdsourcing*, defined as "the practice of obtaining needed services and content by soliciting voluntary contributions in the form of an open call from a large network of individuals rather than from an organization's employees or suppliers" (Deng, Joshi, & Galliers, 2016, p. 280), has become a new type of work form. It changes the nature of the work: rather than signing a contract with an organization and clocking in office every day, individuals could conduct work anywhere and anytime, and have the autonomy to choose the jobs they like to complete. Among the three types of crowdsourcing classified by Howe (2008), namely microtask crowdsourcing (MC), creative crowdsourcing, and inducement prize contests crowdsourcing, MC is one of the most expanding trends (Bratvold, 2011), where micro tasks usually are easily completed within a few minutes and compensated with tiny monetary rewards (examples of the micro tasks are survey, product categorization, business feedback, and tagging, etc.) (Deng et al., 2016).

Understanding the success of ICT has been a goal of IS scholars for decades. Prior studies suggest that it is the users' turnover that determines long-term viability of an ICT and its success (Bhattacharjee, 2001). Compared with acquiring new users to initially adopt an ICT, retaining the existing users may cost far less (Bhattacharjee, 2001). Different from traditional ICT that usually involve one type of users, the MC platform contains two types of users – *requesters* releasing micro tasks, and *crowd workers* conducting these tasks. Compared with the large body of research conducted from the requester perspective (Finnerty, Kucherbaev, Tranquillini, & Convertino, 2013; Harris, 2011; Kittur et al., 2013), prior studies pay less attention to the crowd workers. Specifically, although there are some studies focusing on the crowd workers' motivation to initially participate in MC platforms to work (Kaufmann, Schulze, & Veit, 2011; Zheng, Li, & Hou, 2011), the determinants of their turnover intention of MC platform are still underexplored. The turnover intention of the crowd workers is defined as the intention to leave the MC platform and high turnover has been pointed out as one of the most important challenges of MC platforms (Hossain, 2012). Without knowing the antecedents of crowd workers' turnover intention, MC platforms cannot build an effective motivating incentive structure to sustain workers (Hammon & Hippner, 2012). Thus, it is crucial for practitioners and academics to understand what factors influence the turnover intention of crowd workers.

The turnover intention of crowd workers of MC platform may be influenced by both requesters and platform characteristics, as crowd workers are not only interacting with the requesters for tasks but also the platform for information. On the one hand, crowd workers are vulnerable to be exploited by requesters because requesters have the power to determine whether to pay the workers or not after they finished the tasks. Therefore, crowd workers are more likely to leave a platform if their overall perception on requesters on the platform is not fair enough. On the other hand, the characteristics of the MC platform itself may also influence the worker satisfaction that is an important factor leading to turnover intention (Chen, Yen, & Hwang, 2012; Seol, Lee, Yu, & Zo,

2016). Therefore, it is important to investigate the turnover intention of crowd workers of MC platforms from both the requester and platform perspectives.

In addition, crowd workers on the MC platform have different identities. Some of them are full time workers, whose income wholly comes from completing micro tasks, while some others do it only for enjoyment or skills training. These different identities of crowd workers may further influence the relationships between the above-mentioned factors and workers' affective responses, which in turn influence their turnover intention. Therefore, it is interesting to explore along this line.

In this paper, we propose a research model to examine what factors influence crowd workers' turnover intention of MC platforms, based on the cognitive-affective model. The cognitive-affective model argues that human behavior is influenced by both cognitive and affective factors (Te'eni, 2001). It has been widely used to study the continuance intention in IS discipline (i.e. Hong, Tai, Hwang, Kuo, & Chen, 2017; H.-W. Kim, Chan, & Chan, 2007). In the context of MC, we propose that workers can first form cognitive judgments based on their experience with their requesters and the MC platforms, which in turn influences the workers' affective response. Finally, the affective response drives the workers' behavior (turnover intention). In addition, the crowd workers' identity is proposed to moderate the relationship between workers' cognitive perception and their affective responses.

LITERATURE REVIEW

Microtask Crowdsourcing and Turnover Intention

MC is an open source form of micro tasks for micropayment (Deng et al., 2016). It is a relatively new market for businessmen and academics to look for labor force and for individuals to earn money. Prior studies have investigated the MC from different dimensions, for example, the importance of the platform's designs to meet stakeholder needs (Kajino, Arai, & Kashima, 2014), the importance of compensation strategy to help requesters to ensure the quality of answered tasks (Finnerty et al., 2013; Kittur et al., 2013), and the importance of governance with the challenges in managing large and external groups of people handling a variety of tasks (Schenk & Guittard, 2011). These studies are usually conducted from the perspective of the platforms or requesters.

There are also a few studies adopting the perspective of task workers, another key stakeholder. For example, Zheng et al. (2011) explore the workers' motivation to participate in the crowdsourcing. They find that intrinsic motivations are more important than the extrinsic ones, while contest characteristics are crucial for intrinsic motivations. Kaufmann et al. (2011) study the crowd workers' motivations to participate in Amazon Mechanical Turk (MTurk). They find the similar results that intrinsic motivations dominate the extrinsic ones, of which task related factors, such as task autonomy, play an important role. However, prior studies have mainly focused on the motivations in leading individuals to initially participate in such a new work form. Little attention has been paid to the workers' continuous usage turnover intention, which has been found to be more important than initial adoption to determine the success of an IT (Bhattacharjee, 2001). In addition, how different types of workers affect the relationship between workers' cognitive perceptions and affective responses that influence their turnover intention is unclear through the literature. People should consider more for the workers if they care about MC's long-term impact on society (Deng et al., 2016).

The Cognitive-Affective Model

Predicting human behavior has drawn scholars' attention in many disciplines. Prior studies have found that it is not only the cognitive factors but also the affective ones matter (Cui, Lai, & Lowry, 2016). A basic idea behind is that affect and cognition take place through a dual-process system that comes together in determining natural human behavior (Chaiken & Trope, 1999).

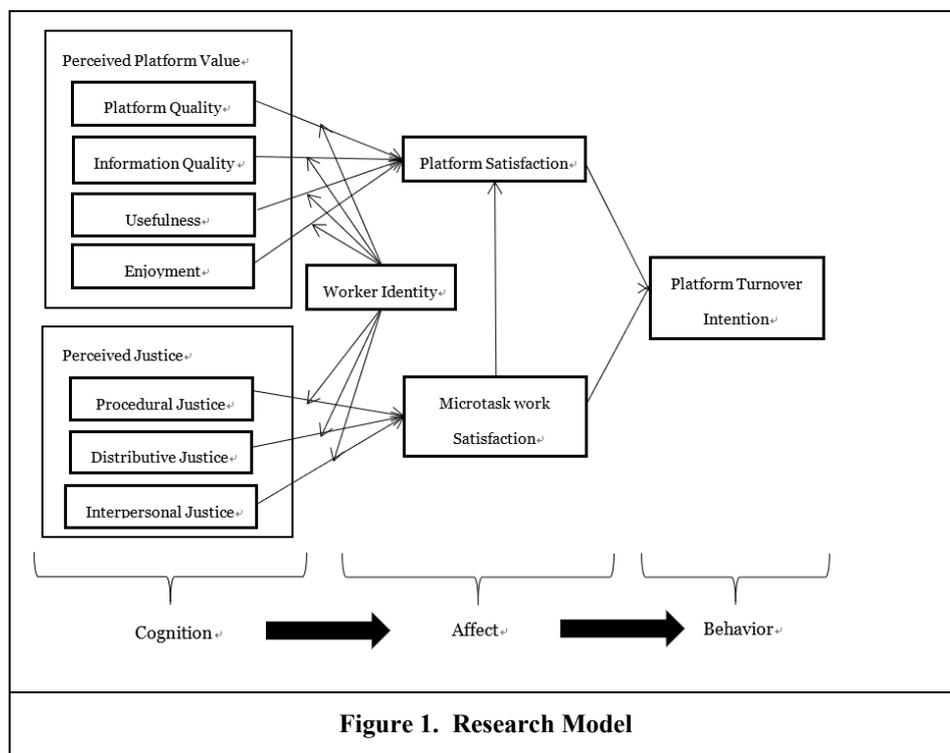
Among the cognitive factors, perceived value of IT has been studied as an important dimension (Y. H. Kim, Kim, & Wachter, 2013; Kuo, Wu, & Deng, 2009). Perceived value is defined as "consumer's overall assessment of the utility of a product (or service) based on perceptions of what is received and what is given" (Zeithaml, 1988, p. 14). With higher perceived value, the individuals' affective responses will be more positive. In addition, in marketing and organizational context, perceived justice has been recognized as another important cognitive factor, which may lead to affective responses (Sindhav, Holland, Rodie, Adidam, & Pol, 2006). Many studies have explored the relationship between justice and its behavioral consequence of users (Smith & Bolton, 2002). For example, Zhao, Lu, Zhang, and Chau (2012) find that perceived service providers' justice is positively associated with user satisfaction, which ultimately increases the users' intention to use the service in the future.

User satisfaction has been widely studied as the affective response to the cognitive perception (Zhao et al., 2012). In behavioral IS studies, it has been found that satisfaction results from the users' evaluation of their experience with IT (Melone, 1990). According to the expectation-confirmation theory, customers have expectation towards an IT before their use and evaluation after. If customers' evaluation is better than their expectation, they are satisfied; on the contrary, they are dissatisfied if the evaluation is not

as good as their expectation. In addition, user satisfaction is suggested to be an important dimension of IT success, and has been found to play an important role in decreasing turnover intention for a variety of IT, such as e-learning systems (Roca, Chiu, & Martínez, 2006), and mobile service (Zhou, 2013).

Research Model And Hypotheses

Based on the literature review and cognitive-affective model, we build a research model, as shown in Figure 1. The perceived platform value and perceived justice on requesters reflect workers’ cognitive judgment with the experience while completing micro tasks in the platform, interacting with platform interface and their requesters. Platform satisfaction and microtask work satisfaction reveal the workers’ affective responses to the experience. Turnover intention reflects the workers’ behavior driven by the cognitive and affective responses. Therefore, the model hypothesizes that workers’ cognitive judgments, including perceived platform values and requesters’ justice, lead to their affective responses, including platform satisfaction and work satisfaction, respectively. The worker identity is regarded as a moderator between these relationships. Platform satisfaction and work satisfaction in turn determine the workers’ turnover intention. The hypotheses are presented below.



Perceived value and platform satisfaction

Prior studies have documented a positive relationship between perceived IT value and customers’ satisfaction (Y. H. Kim et al., 2013; Kuo et al., 2009). We believe such a relationship can be generalized to perceived platform value and platform satisfaction in our study. Perceived platform value includes many dimensions. The first dimension is platform quality (also known as system quality), which refers to the stability of a system, for example, the consistency of the system interface, ease of use, response rates in interactive systems, quality documentation, and sometimes, quality and maintainability of the program code (Seddon, 1997). Prior studies have found a positive relationship between system quality and user satisfaction (Chiu, Hsu, Sun, Lin, & Sun, 2005). The second dimension is information quality, referring to the timeliness, relevance, and accuracy of information generated by a platform. Poor information quality may undermine workers’ experience because they need to spend more efforts and time on searching, which results in worse satisfaction with the platform. Prior studies have documented a positive relationship between information quality and user satisfaction (Wixom & Todd, 2005). The third dimension is perceived usefulness that positively affects user satisfaction (Calisir & Calisir, 2004; Joo, Lim, & Kim, 2011). According to the expectation-confirmation theory, the more usefulness users perceive, the more satisfaction they are. For example, if workers find they can indeed earn monetary rewards on the MC platform, they are more satisfied with the platform. The fourth dimension is perceived enjoyment, which refers to the enjoyment of using an IT. Prior studies have also documented a positive relationship between perceived enjoyment and satisfaction (Lin, Wu, & Tsai, 2005). Therefore, we make the following hypotheses:

H1: Platform quality (H1a), information quality (H1b), perceived usefulness (H1c), and perceived enjoyment (H1d) are positively associated with platform satisfaction.

Perceived justice and work satisfaction

Extending from equity theory (Adams, 1963), justice provides a useful perspective for understanding the relationship between workers and their work satisfaction. In the management discipline, various studies have explored the effects of perceived justice of the organizations on job satisfaction (i.e. Gillet, Colombat, Michinov, Pronost, & Fouquereau, 2013; Maxham III & Netemeyer, 2002).

The justice has been categorized into three dimensions: interactional justice, procedure justice, and distributive justice. The first dimension is interactional justice, which refers to the fairness of interpersonal treatment that the workers received (Bies & Shapiro, 1987). Prior studies have found that interactional justice positively affects job satisfaction (Zhao et al., 2012). In the context of MC, workers are interacting with requesters. Fair treatment in such interactions can influence the evaluation of the workers' work satisfaction. The second dimension is procedure justice, referring to the fairness of policies, procedures, and criteria (Maxham III & Netemeyer, 2002). The importance of considering this dimension of justice has been suggested by prior studies, and it has been found to positively influence job satisfaction (Zhao et al., 2012). On MC platform, if the workers feel that their answers to the tasks are evaluated fairly by requesters, they are more likely to be satisfied with their work on the platform. Lastly, distributive justice refers to whether the outcomes are comparable to the inputs (Sindhav et al., 2006). If workers perceive that their monetary rewards are equal to their time and efforts spent, their perception of distributive justice is high, and thus they are more satisfied with their work. Prior studies have also documented a positive relationship between distributive justice and work satisfaction (Daileyl & Kirk, 1992). Therefore, we make the following hypotheses:

H2: Perceived interactional justice (H2a), perceived procedure justice (H2b), and perceived distributive justice (H2c) are positively associated with work satisfaction.

Relationship between two types of satisfaction

As the platform and requesters are two separate entities, the satisfaction with each entity should be viewed distinctly. The evaluation of the platform is influenced by the evaluation of the requesters in the platform. As the evaluation of requesters may vary from experience to experience, workers may have an overall evaluation of all the requesters they encounter on the platform, which influences their evaluation of the platform. If workers are not satisfied with most of the tasks they accomplish, their evaluation of the platform tend to be low. On the other hand, if workers are more satisfied with the tasks, they are more likely to be satisfied with the platform as they may think consider the reasonable requests as part of the platform.

H3: Work satisfaction is positively associated with platform satisfaction.

Worker satisfaction and turnover intention

Satisfaction plays an important role in leading to workers' subsequent behavior (Oliver, 1980). Prior studies have found a positive relationship between satisfaction and continuance usage of IT, and a negative relationship between satisfaction and turnover intention (Tett & Meyer, 1993; Zhao et al., 2012). In the context of MC, if the workers are more satisfied with the platform, they are more willing to participate in the tasks on the platform in the future instead of leave the platform. In addition, work satisfaction also influences the turnover intention of the platform. If the work satisfaction is high, workers may be less likely to leave with the reasonable requesters on the platform. Moreover, a stable relationship between workers and requesters, results from the high work satisfaction, can also encourage the workers to stay.

H4: Platform satisfaction (H4a) and work satisfaction (H4b) are negatively associated with turnover intention.

Worker identity moderator

Crowd workers engage in the MC platform with different purposes. For example, some workers are taking part-time jobs, motivated by the willingness to help others, while some are taking full-time jobs to earn money. These different purposes of the workers with different identities lead to different expectations of them. On the one hand, full-time workers, who take micro tasks as their only jobs, may be more sensitive to whether the requesters are fair or not. On the other hand, part-time workers, who are motivated by helping others or improving their skills, may concern more about the platform design and information provided. According to the expectation-confirmation theory, if users' expectation toward an IT is confirmed, they are more satisfied with the IT and then are more likely to engage in the future (Bhattacharjee, 2001). Therefore, the work identity may have moderating effects

between the perceived platform value and platform satisfaction, and the perceived justice and work satisfaction. Therefore, we hypothesize:

H5a: The effects of perceived platform value on platform satisfaction are greater for part-time workers than for full-time workers.

H5b: The effects of perceived justice on work satisfaction are greater for full-time workers than for part-time workers.

Measurement

To measure the constructs in our research model, validated items used in the literature were adapted in this study. All items were adapted to fit the MC context. The measurement scales of platform quality and information quality were adapted from Zhou (2013) and Kang and Lee (2010). Perceived usefulness measurements were adapted from Davis (1989), and perceived enjoyment measurements were adapted from Seol et al. (2016). The three justice measurements were adapted from Colquitt (2001) and Zhang, LePine, Buckman, and Wei (2014). To measure the two types of satisfaction, four items are adapted from Bhattacharjee (2001) to measure platform satisfaction, and five items are adapted from Mak and Sockel (2001) and Mitchell, Smyser, and Weed (1975) to measure the workers' work satisfaction on MC platform. Lastly, five items were adapted from Bhattacharjee (2001) and Zhou (2013) to measure workers' turnover intention of MC platform. Thus, a total of thirty-four items were used to measure all the constructs in the research model. For each item, a seven-point Likert scale was used with anchors from "1=strongly disagree" to "7=strongly agree"

Conclusion and Ongoing Work

This study aims to explore what factors influence crowd workers' turnover intention of MC platform. Based on the cognitive-affective model, we propose a conceptual model to understand how perceived platform value and perceived justice influence workers' turnover intention through satisfaction. In addition, we are interested in studying the moderating effect of worker identities.

In the next step, we will collect empirical data to test our research model. As the biggest MC platform, MTurk provides us an opportunity to collect a large sample to test our hypotheses. The well designed questionnaires will be distributed to workers, and each participant will receive 2 dollars (MTurk suggest the monetary rewards should be 6\$ per hour). In addition, in order to alleviate the common method bias, which is usually a serious problem in survey study, we are going to adopt a three-wave data collection method. That is, at t1, we will be hiring workers to report their assessments of the four perceived platform value constructs and three perceived justice constructs. At t2, we will hire the same workers in t1 to report their overall work satisfaction and platform satisfaction. At t3, the same workers will be hired to report their platform turnover intention, their demographic information, and their work identities (part-time or full-time workers). Each phrase will be lagged around one week.

Then, structural equation modelling would be adopted for examining the model and testing our hypotheses. We hope that this study could broaden our knowledge on turnover intention of crowd workers. First, by proposing the conceptual model, this study provides a comprehensive picture of how the platform and requesters influence crowd workers' turnover intention of MC platform. Future research on such a two-side market could follow the same idea to consider not only the requesters and platforms but also the workers. In addition, the classification of worker identities could provide implications to both platforms and requesters on how to improve worker satisfaction and reduce their turnover intention according to their different identities.

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What drives customer satisfaction and well-being in ridesharing? A developing country perspective

(Work in Progress)

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ABSTRACT

This study examines ridesharing services from the customer perspective in a developing country context and investigates two significant post-adoption and marketing consequences: satisfaction and well-being. Using a purposeful sampling technique, six semi-structured in-depth interviews were conducted in Sindh province, Pakistan. Among the major findings are that customers' awareness of the services and how to use the mobile application, convenience of use, high perceived value, the quality of information available in the ridesharing mobile app, real-time location services, and an effective complaint resolution mechanism promote customer satisfaction and well-being. This study includes implications and an agenda for future research.

Keywords: Sharing economy, ridesharing services, consumer satisfaction, consumer well-being, Sindh

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INTRODUCTION

Sharing or collaborative economy services, defined as an innovative business phenomenon that allows the consumer-to-consumer exchange of underutilised or idle goods and services via mobile apps (Qian and Ukkusuri, 2017), have disrupted traditional business models with new, innovative, affordable, and shared services and affected consumer behaviour. The shared, or collaborative, consumption phenomenon is rapidly changing consumers' values. These developments may also be quickly disrupting the less environmentally friendly capital-intensive industry and other sub-sectors of the economy. The sharing economy business models are becoming the cornerstone of investment, environment protection, consumer choice, and regulation.

Mobile technology now serves as the backbone of communication for both established industry players and start-ups and provides several benefits to consumers and industries, such as convenience, low-cost services, and access to new markets. Motivated by mobile technology, business models started evolving from being company-, product-, or service-specific to become more sharing-oriented and collaborative, allowing the wider stakeholder to share, collaborate, and grow. These sharing-based business models, which are widely considered more elastic and ambitious than traditional business models, are gaining immense attention from consumers, industry, national governments, and regulators for their ability to infuse economic activities (such as creating new employment opportunities) and new revenue streams for the sharing partners. According to PwC (2015), the global sharing economy is forecasted to grow to 335 billion USD by 2025, up from 15 billion USD in 2014.

Nonetheless, despite the sharing economy's impressive growth projections, benefits, and significance in the everyday life of the consumer, the research on it is still in its fledgling stage (Hamari et al., 2015). Moreover, sharing economy firms (including those for on-demand ridesharing) are still relatively young and undeveloped, and sharing services as an alternative method of consumption are still at the beginning of the S-curve, with limited empirical research (Wallenstein and Shelat, 2017; Kim et al., 2018). For example, according to a recent market survey report, Forrester (2018) believes that the sharing economy has plenty of room to grow. Less than 27% of US adults have used a sharing service in the past six months, one-fifth have used a vehicle-for-hire service, only 9% have used room and lodging services through sharing economy, and less than 4% have used vehicle/bike/goods-sharing and logistics services.

Although it is widely believed that the sharing economy now occupies a significant position in consumers' everyday lives, it is not clear whether it has enhanced customer well-being. Earlier research has examined consumer well-being in the context of social media usage (e.g. Facebook, Friendster, and MySpace) (Jang et al., 2018; Valkenburg et al., 2006), bike-sharing in China (Ma et al., 2018), and personal blogging (Jung et al., 2012). A significant portion of published scholarly research is in the area of ridesharing services (e.g., Kim et al., 2018; Wang and Mu, 2018; Peticca-Harris et al., 2018; Urbinati et al., 2017), particularly examining two popular mobility services (Uber and Lyft taxi service) in a developed country context (USA and Canada). However, other similar on-demand ridesharing services are seldom examined, especially in an emerging and developing country context. Understanding the characteristics of ridesharing services that promote customer well-being is an important area of research yet to be adequately addressed in Asia, Africa, and certain European countries.

For the sake of this study, some terms, such as ‘consumer’ or ‘rider’ and ‘driver’ or ‘captain’, are considered the same and have been used interchangeably.

RESEARCH QUESTIONS

How does ridesharing generate consumer satisfaction and well-being? Specifically, how does ridesharing service usage relate to consumer satisfaction and well-being?

LITERATURE REVIEW

The rise of the sharing economy for products and services is a global phenomenon, especially in emerging countries with high population density, stable telecommunication networks, and scarce resources. An increasing number of people in emerging and developing countries now use shared products and services in their everyday lives.

In the understanding of Rinne (2017), the sharing economy refers to the sharing of underutilised assets, monetised or not, in ways that improve efficiency, sustainability, and community. Various academic researchers have examined the sharing economy, and the term ‘sharing economy’ may be subsumed under terms such as ‘access economy’, ‘gig economy’, ‘peer-to-peer markets’, ‘collaborative consumption’, ‘access-based economy’, and ‘commercial sharing systems’ (Parente et al., 2017; Davidson et al., 2018). Nonetheless, recently, differences among these terms have been observed and widely accepted. For example, Fraanje and Spaargaren (2019) argued that collaborative consumption is a subset of the ‘sharing economy’. Likewise, according to Baumber et al. (2019) and Frenken and Schor (2017), the sharing economy largely involves the exchange of or access to underutilised physical goods, and the skill-sharing category generally relates to the ‘on-demand’ or ‘gig’ economy.

Prior research (Parente et al., 2017) published in the area of the shared economy argues that the success of sharing economy firms such as Airbnb, Uber, Lyft, and Careem is powered by various factors, such as increasing consumer trust, the ubiquity of the internet and portable devices, declining transaction costs, cloud computing, freely downloadable mobile car-hailing applications, the abundance of goods in idle capacity, and growing consumer concern regarding environmental sustainability. Transport sector remains the dominant mode of passenger transport, and passenger cars contribute almost 45% of the transport sector’s emissions in Europe alone (European Environment Agency, 2015).

Consumer well-being, also referred to as human well-being (Ayala-Azcárraga et al., 2019), is defined as a broad category of phenomena that includes users’ emotional responses, domain satisfactions, and global judgments of life satisfaction (Ma et al., 2018). Initially, Ko and Kuo (2009) defined user well-being as users’ consciousness and feelings about their lives, including pleasure perception, positive emotions, and higher satisfaction. Suggesting a more comprehensive definition, Ayala-Azcárraga et al. (2019, p. 28) has defined well-being as ‘a state of the human being that arises when good health is maintained, social relationships of trust and cooperation are established, and individuals and groups can act to pursue their goals so that they are satisfied with their lives’.

RESEARCH METHODOLOGY

A qualitative research approach (semi-structured in-depth interviews) was adopted to collect empirical data from male and female respondents familiar with ridesharing services. The interview protocol was designed and pre-tested on a group of randomly selected people in the city of Karachi in July 2019 using ridesharing services for the last six months. Skype application was used to conduct the pilot test. Based on the feedback received during this pilot test, the interview protocol was refined in the language, quantity, quality, and relevance of the questions, and local culture and norms were taken into consideration.

The city of Karachi in Pakistan (the Sindh provincial capital) was selected as a study site for interviews for several reasons. First, Karachi is considered the gateway to Pakistan, with major seaports and airports located in this city. Second, Karachi is a major industrial and financial hub, with over 12 million population providing high demand for sharing services. Third, Careem (Similar to Uber) started its services in Karachi in early 2015. Fourth, the Sindh provincial government has facilitated the establishment and the growth of the ridesharing services (such as Careem, Uber) in the Sindh province to achieve the region’s digital future targets.

The study participants were selected using purposeful sampling technique: participation in the study was purely voluntary; the study participants, both male and female, should own a smartphone; they should have been using Careem or Uber mobile ridesharing application for at least one year; and they should have taken at least 15 rides during the last year. The interviews were conducted face-to-face and tape-recorded, and the interviews were focused on how interviewees have understood the well-being aspects while using shared services.

RESULTS

The participants were asked several questions to examine their level of satisfaction with the ridesharing service and the effect of ridesharing services (Careem or Uber) on increasing their quality of life and meeting their everyday goals, such as reaching the office on time; attending festivals, concerts, and other social gatherings; and going shopping.

Following are some of the themes that emerged from the interview transcripts that resulted into increasing the consumer satisfaction and well-being.

User Awareness

When asked how they came to learn about Careem or Uber services, out of the six respondents interviewed for this study, five (or over 80%) had not received any message from Careem or noticed any advertisements from Careem or Uber on any channel such as social media. Instead, they received referrals or recommendations from their family and friends. In other words, word-of-mouth dominates the adoption and usage of ridesharing services in Pakistan.

'I was living in a student hostel. Someone introduced me to Careem and ordered a ride for me using his mobile car-hailing application. As soon as I took the first ride, I downloaded the application and started using the Careem service. It has been a good experience, and I have been happy using this service for the last three years'. (Sidra, 27, Female, Student)

User perceived security and trust

Technological advances are largely considered to be key enablers of ridesharing and other sharing services (Agatz et al., 2012). Examining the necessity and the importance of ridesharing services in achieving the user well-being, the three female respondents responded the technological benefits of using the Careem service. For example, these technological benefits include ridesharing mobile ridesharing applications provide several options, including viewing the real-time location of the car and details about the driver/captain. The following interviewee's statements illustrate this observation:

'Considering the prevailing law and order situation in the country, when a user orders a ride, Careem sends the details of the driver and the car, including the full name/picture of the driver and also the registration number/model/colour of the car, which allows me to verify the driver's identity and car. I share the location as well as the details of the driver/captain with my family and friends. In case of any unwarranted incident or situation, my family and friends can easily locate me in real-time. This increases my trust in the ridesharing services as well as provides me and my family peace of mind'. (Sassi, 32, Female, Employee)

'I consider using Uber very secure and tension-free. I do not need to carry cash. I can store my credit card information in the app for easy and secure payment. It is becoming a part of my lifestyle. Uber provides a convenient transit option'. (Punhu, 37, Male, Entrepreneur)

Prior research (Hawlitschek et al., 2016; Belk, 2010) has considered customer trust in sharing services one of the key motivations to use the sharing services. Regarding trust and the transparency of information available in the ridesharing services compared to traditional taxi services, all the respondents had favourable viewpoints and explicitly described positive correlation among the level of trust, transparency, and customer well-being.

'One of the important built-in features of the ridesharing mobile application is in advance calculation and information about the distance to my destination as well as the estimated fare. I can, therefore, easily decide if I should take the ride or ignore it. Bargaining on fare bothers me a lot, and the Careem application is, therefore, keeping me happy and at peace'. (Zulfiqar, 38, Employee)

Perceived value

One respondent recorded his increasing level of satisfaction and well-being thanks to the company policy of providing promo codes that allow handsome discounts as well as free rides:

'As compared to the traditional taxi that does not provide any discount or quality service, Uber is special. Good value for the money'. (Tunio, 21, Male, Student)

The relationship between the quality of the ride (car) and consumer well-being was also examined. Here, poor car quality (e.g. old age and poor maintenance) of car was considered the main source of damage to consumer well-being despite transparency in information, a good mobile ridesharing application, and increased convenience. This is, perhaps, due to the hard weather conditions that demand the car air conditioning system working nicely.

'The weather conditions in Sindh are very hot and humid. When I book an Uber, I am sure that it provides air conditioning facility as compared to traditional taxi service. Sometimes, when I find the A/C out of order, it kills the very purpose of booking the ride. The quality of the car/ride is deteriorating day by day'. (Sanwal, 22, Male, Student)

Complaint resolution mechanism

In the case of a dispute or complaint, Careem provides multi-channel options for lodging the complaint, including direct email, telephone, and mobile chat. Half of the respondents confirmed they had received responses to their complaints within 12 hours, and most of the complaints were resolved to their satisfaction. Citing a special case, one respondent narrated the following critical incident:

'One day, while travelling from Islamabad city to Karachi, I ordered a Careem taxi from the Karachi airport. The details of the driver/captain who accepted my ride appeared on my Careem mobile application. As soon as I reached the departure gate, I found a Careem taxi with a different driver and different car registration number. The driver, to my surprise, called my name and asked me to take the ride, I refused to take this ride because of the security concern and immediately called Careem and informed them about the situation. The Careem representative appreciated my complaint as well as the decision to refuse to take the ride. The Careem representative booked another ride for me, and within 10 minutes, the driver came to pick me from the airport. At least, if anything happens, I can share the details of the driver and the car with the company. Accepting an unknown ride was risky and not advisable. Careem's complaint resolution mechanism was very effective. I am happy and satisfied'. (Brohi, 39, Male, Teacher).

DISCUSSION AND THEORETICAL/MANAGERIAL IMPLICATIONS

In this study, we have evaluated some critical factors that promote consumer satisfaction and well-being through ridesharing services in a developing country context. In total six semi-structured and in-depth interviews were conducted and analysed.

This study provides some theoretical contributions. For example, our empirical results show a strong relationship between various components of ridesharing services and consumer well-being. Among the various dimensions of ridesharing services that promote consumer satisfaction and well-being are consumer awareness about the services and how to use the mobile application, convenience of use (anyone can have a ride to anywhere at his or her fingertips), cost effectiveness, high perceived value (promotions, discounts, and cost savings), quality of information available in the ridesharing mobile app, real-time location services, and an effective complaint resolution mechanism (responsive customer service platform across multiple channels, such as email, phone call, or mobile chat). These findings are partially in line with the earlier findings Ma et al. reported (2018) in the context of bike-sharing services.

This study also provides some meaningful managerial implications for the sharing economy. For example, the findings of this study will assist marketing executives in better understanding customers' ridesharing usage behaviour. Moreover, it appears to be explicit from the opinion of the respondents that a lack of consumer awareness about ridesharing services in a developing market such as Pakistan hinders the development of this industry on a large scale despite the country's having a huge consumer market of over 200 million residents. Also, smartphone usage, a key enabler of ridesharing, surpassed 55 million users in 2018 (PTA, 2019) thanks to high-speed internet. This massive proliferation of cell phone usage in the country indicates a high level of mobile self-efficacy among various consumers. Therefore, companies facilitating ridesharing services in the metropolitan cities of Pakistan should design and implement a comprehensive consumer awareness campaign using various channels such as cell phones (Short message service-SMS), social media, print media, and electronic media. Also, the quality of the ride or cars should be ensured by the company, and the usefulness of the service should be further enhanced in order to encourage the upper or elite class in the country to use ridesharing services.

This study has limitations; since the data were collected from a single location, the findings cannot be generalised, and it would be difficult to establish cause-and-effect relationships. The benefits of using car-hailing services are not limited to customer satisfaction and increased well-being, so future research should consider additional outcomes of using car-hailing or shared services, including utilitarian, social, and hedonic aspects of ridesharing services and their effects on customer satisfaction and well-being. Comparative studies of two different cultural backgrounds and socioeconomic differences, such as developed and developing countries, could provide better insight into customer behaviour regarding shared services. Also, the scope of sharing or collaborative services includes various services or options, such as media and entertainment (Spotify), hospitality and dining (Airbnb), retail and consumer goods (Boatbound), and so forth. Future research may examine different sharing services with valuable theoretical, social, and practical implications. Finally, in addition to the customer well-being, the focus of this study, driver well-being and motivation for participating in ridesharing and utilising his or her assets should be examined in both developed and developing countries.

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What Kind of Answer will be Better: Exploring the Features of High-quality Answer Contents in Social Q&A Community

(Work in Progress)

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ABSTRACT

The rigorousness, professionalism and seriousness of answer contents in social Q&A communities have declined sharply. It is of great significance to tell users how to provide excellent answer contents. The purpose of this research is to explore what features of answer content are more likely to make a high-quality answer. For this purpose, the research, taking “Zhihu” as an example, collects the data of answer contents with a crawler, combines initial analysis of the answer contents with related research literature, and selects 9 features that may have impacts on the quality of answer contents. Then the supervised machine learning method will be used to explore the features that can really affect the quality of answer contents, so as to provide reference for guiding users to provide high-quality answer contents.

Keywords: social Q&A community, high-quality answer contents, features, supervised machine learning

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INTRODUCTION

With the continuous development and wide application of information and communication technology, the traditional mode of knowledge dissemination has undergone tremendous changes. Users are no longer confined to the keyword-based search engines to acquire knowledge, but also can ask questions and seek for answers in the social Q&A communities. A social Q&A community is the product of the combination of traditional knowledge dissemination network and Internet technology. Users can use this kind of community to ask questions that need to be solved and get answers from other users to solve the problems. Users can also answer questions on the community and view the best questions, answers or respondents in the community. At present, the representative social Q&A communities are “Yahoo! Answers”, “Quora”, “Zhihu” and so on.

Social Q&A community creates value through the connection of questions and answers that provided by users. On the one hand, there are no entry conditions for users who want to answer questions. Users from all walks of life with different identities and backgrounds can answer questions. On the other hand, there are huge differences in knowledge reserve, motivation and information literacy among different users. These factors make the quality of answers imbalanced, which is embodied in the simple and random form of answers. As a result, the rigorousness, professionalism and seriousness of the whole social Q&A community have declined dramatically. In this context, how to enhance the rigor of social Q&A community and guide users to provide higher quality answers is worthy of in-depth discussion.

In order to improve the professionalism of social Q&A community and guide ordinary users to provide high-quality answers, we focus on the answer content itself, without considering the differences in respondents’ abilities and other users’ evaluations, try to address this research question: What features of answer content are more likely to make a high-quality answer? Answering this question can help guide users of social Q&A community to give higher quality contents when answering questions. To this end, this research, taking China’s most well-known social Q&A community “Zhihu” as the research platform, collects user’s answer contents with a crawler program, and explores various features that can affect the quality of answers by using the method of supervised machine learning. Findings of this research could provide suggestions for users to make higher quality answers from the perspective of content form, and provide strategies for the functional optimization of social Q&A communities from the perspective of user requirements.

The rest of this paper is organized as follows. Firstly, we review the related literature from 2 aspects, including evaluation of the quality of answer content and features of answer content. We then introduce the research method, and give the process of feature selection. Research data collection and preprocess will be discussed later. Finally, we conclude the current research work and present the plan of the future work.

RELATED LITERATURE

Evaluation of the Quality of Answer Content

Because of the uneven quality of user-generated answer content in the social Q&A community, it has become a hot topic for researchers to evaluate and rank the quality of answer content from the perspective of readers. The key to the evaluation of the

quality of answer content is to determine the evaluation criteria. Through content analysis and iterative induction of the types of comments, seven criteria for choosing the best answers were deduced: content value, cognitive value, social emotional value and information source value, external value, utility and general statement (Kim et al., 2008). Shah et al. (2010) took Yahoo! Answers as a research object. By comparing the criteria of selecting the best answer between expert group and questioner, 13 criteria affecting users' choice of the best answer were determined. Based on these criteria, a classifier was trained to classify the quality of answers. The number of points praised by answers can be the criterion of high-quality answer. On this basis, some researchers studied the specific features that may affect the quality of the answers. Li et al. (2015) found that respondents' credibility and timeliness of answers, as well as the length of answers, were positively correlated with the quality of peer-judged answers. The quality of peer-judged answers was affected by the inclusion of social elements in the answers. Jeon et al. (2006) evaluated the quality of answers from 12 non-textual features, such as number of clicks, length of answers, and active level of respondents. Empirical data show that the model can improve the accuracy of evaluating the quality of answers. Li and Zhang (2018) directly used the number of praise points obtained by the answers as the criteria for high-quality answers, and explored the influencing factors of perceived usefulness of knowledge sharing users. The results showed that the features of answers (timeliness, pictures or citations), the quality of answers (answer-centeredness, emotional support), and the features of respondents (social network-centeredness, credibility) have a positive effect on the voting of answering usefulness, and the linguistic diversity of answers has a negative effect on the voting of answering usefulness.

To figure out what feature may increase the probability of the answer being cited, Calefato et al. (2015) conducted a research on the user answer content of Stack Overflow and found that technical-style has a positive impact. User's reputation may be a major influencing factor, Lin and Shen (2015) propose a SmartQ model, which uses a reputation management system based on categories and topics to evaluate users' willingness and ability to answer various questions. However, Liu et al. (2015) believed that previous works analyzed the answer quality (AQ) based on answer-related features, but neglect the question-related features on AQ. Previous work analyzed how asker- and question-related features affect the question quality (QQ) regarding the amount of attention from users, the number of answers and the question solving latency, but neglect the correlation between QQ and AQ (measured by the rating of the best answer), which is critical to quality of service (QoS). Aiming at the unbalanced quality of answer content, Jin and Li (2016) constructed a real-time monitoring framework of user generated content quality based on SPC from the perspective of UGC creation process.

Features of Answer Content

In the study of the features of the answer content, following the early exploratory study from the answer content itself (S. Oh et al. 2008), researchers pay more attention to a specific subject area and study the features of the answer content in specific areas. Jeng et al. (2017) explored the features of the answers on the "ResearchGate" by combining qualitative content analysis and quantitative statistical analysis methods, and whether these features exist in different disciplines. The conclusion indicates that the type of problem and the difference in the subject will have an impact on the features of the answer. Oh et al. (2013) studied the linguistic features of Yahoo! Answers's eating disorders from three dimensions: answer content, answer style and sentiment analysis. By comparing the responses of the two categories of social emotional problems and information problems, it was found that the needs of different questions constituted different features of the answer content. Negative emotional words are used extensively in social emotional problems, while the answer to information problems uses more complex, precise and objective feature words.

Some researchers have carried out in-depth research on the demonstration mode of the answer content. Ruan and Xia (2018) applied topic models to the recognition semantics of high-quality user-generated content to mine the features of high-quality user-generated content. Based on the analysis of the features of social platform users, the user-generated content theme model based on LDA was constructed, which demonstrated the relationship between high-quality user reviews and topic distribution. The difference in the subject will have an impact on the features of the answer. From the perspective of discussion patterns, Savolainen (2012) used five main discussion mode which Toulmin (2003) proposed to analyze the answers to the 100 global warming questions on Yahoo! Answers which found that the most commonly used discussion was statement, followed by rebuttal and non-rebuttal, and a mixture of multiple discussion modes. In most cases, respondents will support their opinions with personal opinions and experience. At the same time, the research results show that the use of rebuttal and mixed discussion mode will make the answer have better quality and credibility than the statement and non-rebuttal argumentation model. Furthermore, Savolainen (2013) analyzed the answers to the rebuttals and mixed discussion models obtained in the above study. By exploring what kind of information resources the respondents use to support refutation, it is found that questioning the rationality of other answers and their background assumptions is the most frequently used method, and the respondents will also question the motivation of other respondents. At the same time, the study found that respondents mainly use information resources on the Internet as resources to support refutation. Then Savolainen (2014) studied the features of answers from the perspective of rhetorical strategies. Based on the rhetoric theory put forward by Borchers (2018), it is believed that the rhetoric strategies of explaining reasons, results and authority are most commonly used. At the same time, it is found that respondents will use scientific information resources to support their rhetorical strategies, such as research institutions' websites or persuasive video resources.

Summary of Literature Review

Through the review of relevant literature, it can be found that researchers have made in-depth research on the content and quality of answers in social Q&A communities, especially the evaluation of the quality of answers, which provides us with

ideas for further research on the features that can affect the quality of answers. Currently, most of the research focuses on how to evaluate the quality of an answer and how to rank the answers, aiming at helping find out better answers. However, this research from the perspective of users, studies what features of answer will lead to a higher quality answer, so as to help users input better answers and help social Q&A communities improve their question answering functions.

RESEARCH METHOD

This research will be based on a large amount of answer content data on “Zhihu”, using machine learning method to explore answers with which features are more likely to be high-quality answers. With the development of computer technology and the reduction of the cost of collecting and storing data, a large amount of data has been accumulated in various fields of people’s lives, thus providing a wider range of uses for machine learning. Machine learning methods are usually divided into supervised learning, unsupervised learning, and reinforcement learning. This classification is based on the fact that if the training data entered by the learning system contains existing experience. The training data for supervised learning includes real results with known tasks. These results can be used to evaluate the pros and cons of learning outcomes. Common supervised learning includes regression analysis and statistical classification. There is no real result known in the unsupervised learning, which means it does not contain the existing empirical knowledge. In the learning process, it is necessary to establish an evaluation method for the learning result. The common unsupervised learning is clustering. The empirical knowledge of reinforcement learning comes from the feedback of the environment in the learning process, sometimes there will be delays.

Specifically, this research will use the regression analysis algorithm in supervised learning classification. The experimental data source is the answers under the topic of “Computer Science” on the “Zhihu” social Q&A community. According to the initial analysis of the collected answers and the existing related research on the quality of answer content, we filter out all the possible features that may affect the quality of the answer. When collecting the answers of each question, the original order of answers is retained. The order is determined by the ranking mechanism of “Zhihu” that follows the principle of weighted voting. The top-ranked answer endorsed by other users reflects the high quality of the answer content. Therefore, we take the top 10% of the answers as high-quality answers and mark them as positive samples; the last 90% of the answers are normal answers and are marked as negative samples. Under the premise of determining the specific features and sample values, the appropriate regression analysis algorithm will be used to train and analyze the data set, and feature evaluation is used to explore which features can improve the quality of the answer content.

FEATURE SELECTION

By observing and analyzing the high-quality answers on “Zhihu”, and combining with the existing related research on the answer content of social Q&A community, we filter out all the possible features that may have an impact on the quality of the answers. The selected features are shown in Table 1.

Text Features of Answer Content

When users read the answers, the length of text and the number of paragraphs might be the factors that directly affect users’ acquisition of key knowledge points. To some extent, the longer text and the more paragraphs will show a more detailed answer, which is helpful to users’ in-depth understanding. However, it’s relative low efficiency to acquire key knowledge points. Therefore, in this research, the length of the text and the number of paragraphs are taken as two text features of the answer content. It happens frequently that quoting massive data to demonstrate the viewpoint can increase the credibility of the answer. Meanwhile, marking key sentences can help users quickly locate the key points of the answer. Also, the number of data (times of data-quoting) contained in the text and marked sentences are also taken into account in this research. The different social Q&A community platforms will form some unique style of user’s answer content, which is reflected in some unique words in the platform, such as “Thanks for inviting”, “Respondent lives in the United States”, “Just got off the plane” and so on in “Zhihu”. Therefore, this study regards the frequency of these unique words as a textual feature.

Rhetorical Features of Answer Content

Compared with the pure text content, users prefer the photo-illustrated content, which can not only make the answer more vivid and interesting, but also make the answer more comprehensive and clearer. Borchers’ (2018) research indicates that when explaining the reasons and results and demonstrating authority, respondents prefer rhetorical strategies and use scientific information resources to support their strategies, such as citing external pictures and links. In addition, when answering some professional questions, there are often some proper nouns with a hyperlink, which can be linked to help users quickly understand domain knowledge. These words are called keywords. In addition to the answer content itself, the external information resources cited by the answer content are described as the rhetorical features of the answer content. Consequently, we propose three rhetorical features: the number of pictures, the number of external links, and the number of keywords.

Emotional Features of Answer Content

Xu et al. (2016) aimed at user-generated content of information in text form under Web 2.0 environment, used fuzzy statistical method to determine index weight and membership degree of fuzzy comprehensive evaluation, selected appropriate fuzzy synthesis operator through comparative analysis, and established user-generated content fuzzy comprehensive evaluation model FCE based on emotional analysis. Jin (2015) found that emotional support had a positive impact on information adoption. Joyce et al. (2006) found that information with positive emotions helps to enhance user identification. Therefore, this

study regards the emotional value of the answer content as a feature. The emotional value will be calculated by text sentiment analysis method.

Table 1: Selected Features

Feature ID	Feature classes	Feature name	Introduction
F1	Text feature	Text length	The length of answer content text
F2		paragraphs	Number of text paragraphs in answer content
F3		Number of data	Times of data-quoting in answer content
F4		Number of marked	Number of marked sentences in answer content
F5		Number of unique words	Number of unique words in answer content
F6	Rhetorical Feature	Number of pictures	Number of pictures in answer content
F7		Number of links	Number of links in answer content
F8		Number of key words	Number of key words that link to other pages
F9	Emotional feature	Emotional value	Emotional value calculated from the answer content

Source: This study.

DATA COLLECTION AND PREPROCESS

In this research, the social Q&A community “Zhihu” was taken as the research platform, and a total of 87,637 answers were collected under the topic of “Computer Science”. The data set contains all the answers from the questions created until 24 o'clock on September 7, 2019. Each of the collected answers is stored in JSON format and contains question, answer content, and respondent information. According to the total of 9 features in the three dimensions that have been determined, feature values of each answer will be processed and calculated. Currently, the calculation of the eight values under the text features and rhetorical features of the answer content has been completed.

CONCLUSION AND FUTURE WORK

This research takes the answer contents in social Q&A community as research object, and hopes to figure out the features of high-quality answer contents against the common ones. By the relevant literature review, we have established three dimensions: text features, rhetorical features and emotional features of answer content, and then identified 9 features that might affect the quality of answer contents. The study took the social Q&A community “Zhihu” as the research platform, and collected a total of 87,637 answers. At present, the calculation of a total of 8 values under the text and rhetorical features has been completed. In the future research, the emotional value of answer content will be calculated through sentiment analysis. We will use the machine learning method to analyze the data set, and feature evaluation will be used to explore which features can improve the quality of the answer contents. Finally, suggestions to guide ordinary users to provide high-quality answers will be proposed and strategies for the functional optimization will be provided.

ACKNOWLEDGMENT

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Automatic Help System with Voice Input for Passengers of Drop Taxi

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ABSTRACT

With the changes of the times and the advancement of science, there are more and more cars around us. Cars bring great convenience to people's lives, such as drop taxis can be on call, cheaper and convenient. However, in recent years, there have been many incidents of female passengers being killed by drop taxi drivers, which has resulted in many female compatriots not being safely out of the country. This motivated us to develop artificial intelligence systems using voice input to identify crime tendency of taxi drivers. The system we developed uses the keyword input technology of voice input. Specifically, we first build up the keyword library of criminal tendencies based on similar cases reported in news. Then we present the details of how our system recognizes the crime tendency of a driver through what he talked with a female passenger. Finally, we explain how the system automatically takes the corresponding warning or send out help signal to police officers after it identifies a driver has a criminal tendency.

Keywords: drop taxi, speech recognition, artificial intelligence, keyword retrieval, criminal tendency, automatic help.

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Comparative Study of Business Models of Ridesharing Platforms in Lithuania

(Abstract)

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ABSTRACT

The need for sustainable consumption practices is growing, as well as the need for sustainable business models. Sharing economy is promoting sustainable usage of materials, equipment and tools. Moreover, ridesharing is a recognized mean of sustainable mobility. As existing research usually compare sharing economy business models versus more traditional ones, in this study, authors aim to identify differences of business models of ridesharing platforms. The comparative analysis was carried out based on Business Model Canvas framework proposed by Osterwalder and Pigneur (2010). The data on business models of most significant ridesharing platforms operating in Lithuania was collected from secondary sources. The platforms compared in the paper are international (Uber, a global ridesharing service, and Bolt, a regional ridesharing service) as well as local (eTransport, providing ridesharing as an additional option, and CityBee, free-floating car-sharing service provider). Future research will include interviews with representatives of the ridesharing platforms and provide a more detailed case analysis.

Keywords: sharing economy, platforms, business models, ridesharing, Lithuania.

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BACKGROUND

The need for sustainable consumption practices is emphasized on United Nations' Sustainable Development Goals, dedicating Goal 12 to ensure sustainable consumption and production patterns (United Nations, 2015). Under Goal 12 Ensure sustainable consumption and production patterns, United Nations note that "In 2002 the motor vehicle stock in OECD countries was 550 million vehicles. A 32 per cent increase in vehicle ownership is expected by 2020. At the same time, motor vehicle kilometers are projected to increase by 40 per cent <...>" (United Nations, n.a.). Meanwhile sharing economy is promoting sustainable usage of materials, equipment and tools. Moreover, ridesharing is a recognized mean of sustainable mobility (Lee, Lee, & Yoo, 2019) as they reduce number of traveling in single-occupant vehicles, and thus generating externalities in the form of congestion, pollution, and vehicle-miles traveled (Shoshany Tavory, Trop, & Shiftan, 2019). Delloitte (2017) identified that ridesharing continuously grows in double-digit speed and 50% of global ridesharing market is concentrated in Europe. According to Statista (2019), in Lithuania ride hailing user penetration is 7.7% (0.2m) in 2019 and is expected to hit 12.7% (0.4m) by 2023.

As existing research usually compare sharing economy business models versus more traditional ones. Meanwhile, comparisons of ridesharing business models look into specific aspects specific to ride sharing businesses (e.g. Delloitte, 2017). And Cohen and Kietzmann (2014) based their study on Business models for sustainable innovation proposed by Boons and Lüdeke-Freund (2013). In this study, authors aim to identify differences of business models of ridesharing platforms by using more generic Business Model Canvas framework (Osterwalder, & Pigneur, 2010) for comparison.

METHODOLOGY

The purpose of this research is to analyze differences of business models of ridesharing platforms. To compare the business models, this study uses a Business Model Canvas (Osterwalder and Pigneur, 2010) as main framework. It is the most popular approach widely accepted by practitioners and academics.

The cases for comparison were selected based on following criteria: 1) they have to be providing ridesharing service, 2) consumers access the service by using an internet-based platform. In addition to these criteria, authors sought to compare business operating internationally versus ones operating locally only. To choose a local case a Lithuanian market was chosen because of the convenience of understanding sources in local language. A number of ridesharing service platforms operating in Lithuania were identified (see Table 1).

Table 1: Ridesharing Platforms operating in Lithuania

Platform	Geography	Market players	Core service?
Uber	International – Global	C2C	Ridesharing is core service
Bolt	International – Global	C2C	Ridesharing is core service
Opti	International – Regional	C2C	Ridesharing is core service
Yandex Taxi	International – Regional	C2C	Ridesharing is core service

Platform	Geography	Market players	Core service?
eTransport	Local	C2C	Ridesharing is additional service, traditional taxi is core service
eTaxi	Local	C2C	Ridesharing is additional service, traditional taxi is core service
Trafi	International – Global	C2C	Ridesharing is additional service, transit information is core service
eSpark	Local	B2C	Free-floating ridesharing is core service
CityBee	Local	B2C	Free-floating ridesharing is core service

Source: This study.

The platforms compared in the paper are international (Uber, a US based global ridesharing service, and Bolt, Europe based ridesharing service) as well as local (eTransport, providing ridesharing as an additional option, and CityBee, free-floating car-sharing service provider).

To gain deep insights into business models of ridesharing platforms, the qualitative research design was applied following Täuscher & Laudien (2018). This selected approach ensures to collect rich data and more in-depth understanding of ridesharing BMs.

RESULTS SUMMARY

The study has analysed of differences of business models in the context of ridesharing platforms. Moreover, the paper explored four business models (i.e., Uber, Bolt, CityBee, eTransport) and compared them to each other.

The results showed that all four business models have similarities regarding the main value propositions and segments, communication channels (e.g., platform, and social media such as Facebook, Instagram). Interestingly, the main differences are customer segments and value propositions (eTransport offers advertising services (video) for small and medium and big companies; Bolt is going to deliver food), communication channels (Uber is passive on social media; CityBee has the biggest fan base on social media (Instagram)), revenue stream (i.e., advertising and food services) and key activities (e.g., selling of video advertising space on digital screens in eTransport cars; maintenance of social media presence).

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Developmental Problems of Current Cross Border e-Commerce Companies and Countermeasures

(Abstract)

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ABSTRACT

The development of cross border e-commerce industry is one of important global trends. From eMarketer (2019), the global sales of e-commerce in 2018 was 2.5 trillion US dollars and will reach 7.5 trillion US dollars in 2020. In this number - 7.5 trillion US dollars, the cross border e-commerce consumers will occupy 44.6% of e-commerce. Due to the quick development, companies will encounter problems by the way. The research purposes of this paper was to discuss some problems and provide suggestions. During the time of industry-academic cooperation, observational survey was used as the research methodology. The research subjects were 5 Taiwanese cross border e-commerce companies which located in the vehicles components industry and fashion handbag industry. The companies might have over a 30-years-old history or might be a new company. The common factor of these 5 companies are they all use cross border e-commerce multiple platforms to sell their products around the world. The research results and suggestions of these 5 cross border e-commerce companies are the following. Firstly, the problem is business opportunities are difficult to catch recently and the amount of each order earned is becoming smaller. The suggestion for this problem is to suggest adapting multiple cross border e-commerce portals operations on budgets and "Software Key activities" for decision making. The second problem is the cost of cross border e-commerce logistic is high. The suggestion for this problem is to use Big Data Analysis and artificial intelligence (AI) technology to calculate exact oversea inventories. The third problem is lack of trust. The suggestion for this problem is localization strategy, to systematically recruit and train the talents who are familiar with the culture, products and markets. And it should use the third-party money transfer security services.

Keywords: Cross Border e-Commerce; Smart Business; Localization; Oversea warehouse

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Research Background, Motivation and Purpose

The Internet has become an important accelerator for global business. Cross border e-Commerce is the new Silk Road in the era. Base on the report of eMarketer (2019), the global e-commerce sales scale was US\$2.5 trillion in 2018 and will reach US\$7.5 trillion in 2020. In 2020, the amount of consumers in cross border e-commerce will occupy 44.6% in the whole e-commerce market. The number of third-party cross-border business-to-business (B2B) and business-to-customer (B2C) portals and transaction intermediaries both are increasing. Enormous enterprises start their international venturing on such platforms. For example, Alibaba.com offers hundreds of millions of wholesale products to buyers located in more than 200 countries every year (Alibaba.com, 2019). All of these evidences represent the motivation on researching the fields of cross border e-commerce. And due to these quick and big development, companies will encounter problems by the way. The research purposes of this paper was to discuss some problems and provide suggestions. During the time of one-year industry-academic cooperation program with 3 companies, observational survey was used as the research methodology. The research subjects were these 3 Taiwanese cross border e-commerce companies which located in Taiwan's vehicles components industry and fashion handbag industry. One company have over a 30-years-old tenure and the other company is a new company. The common factor of these 3 companies are they all use one or more multiple third-party cross-border e-commerce portals to sell their products around the world.

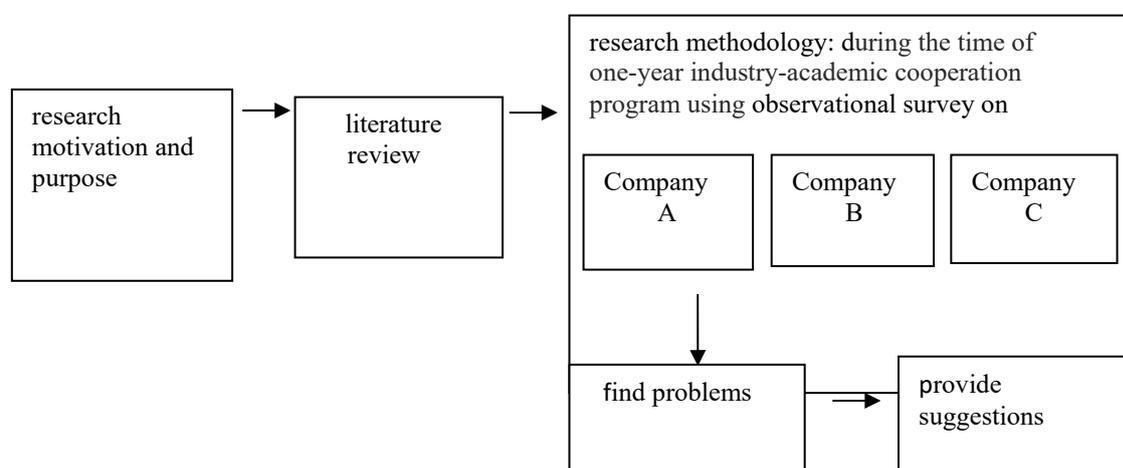


Figure 1: Research Process

Literature Review

The Internet has become an important accelerator for global business trading. The number of third-party cross-border business-to-business (B2B) and business-to-customer (B2C) portals and transaction intermediaries are increasing. Enormous enterprises start their international venturing on such platforms. For example, Alibaba.com offers hundreds of millions of wholesale products to buyers located in more than 200 countries every year (Alibaba.com, 2019). The most important and special innovation of these third-party cross-border portals, for example, Alibaba, Amazon and eBay are all building their own “Ecosystem”. An “ecosystem” is a community of organisms (businesses and consumers of many types) interacting with one another and the environment (the online platform and the larger off-line physical elements) (Zeng, 2018). The ecosystem was built to link buyers and sellers of goods. As technology advanced, more business functions moved online—including established ones, such as advertising, marketing, logistics, training, finance, and emerging ones, such as affiliate marketing, product recommenders, and social media influencers (Zeng, 2018). Cross border e-commerce companies should adapt to grow in ecosystem and develop strategies to require resources from ecosystem. Moreover, these third-party cross-border portals today are not just an online commerce company. They are data-driven companies. The data network coordinate sellers, marketers, service providers, logistics companies, and manufacturers. Because of new capabilities in network coordination and data intelligence that all these companies put to use. The companies adapting and growing in these ecosystem can be called “Smart business”. Smart business is coordinated in an online network and use machine-learning technology to efficiently leverage data in real time. In which most operational decisions are made by machines, allows companies to adapt dynamically and rapidly to change market conditions and customer preferences, gaining competitive advantage over traditional businesses (Zeng, 2018). Conclusively, cross border e-commerce companies should set goal to be Smart businesses which represent the dominant business logic of the future.

Research Methodology

During the time of one-year industry-academic cooperation program with 3 companies, observational survey was used as the research methodology. The research subjects were these 3 Taiwanese cross border e-commerce companies which located in Taiwan’s vehicles components industry and fashion handbag industry. One company have over a 30-years-old tenure and the other company is a new company. The common factor of these 3 companies are they all use one or more multiple third-party cross-border e-commerce portals to sell their products around the world.

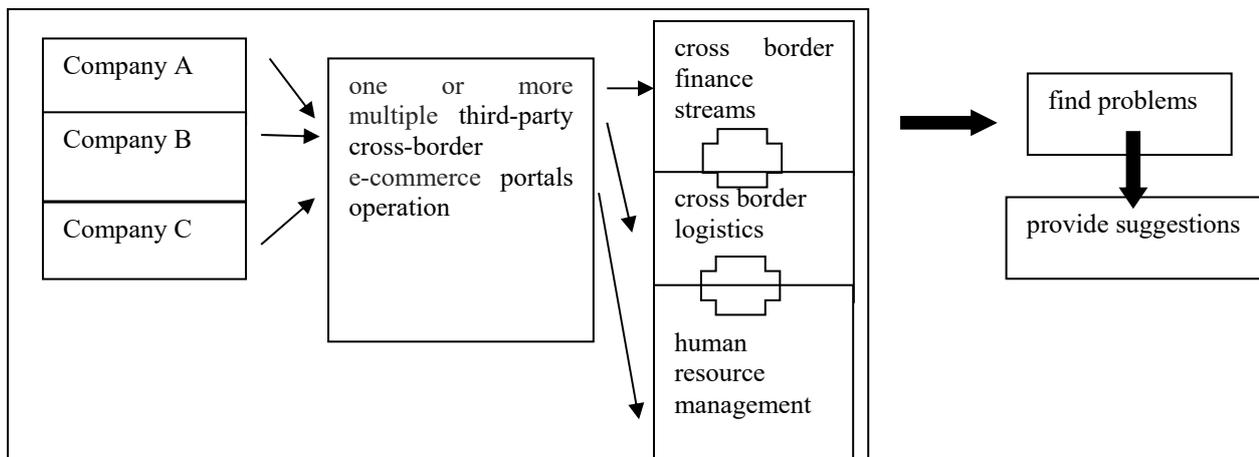


Figure 2 : Research Structure

Research Results and Suggestions

After observational survey was used as research methodology during the time of one-year industry-academic cooperation program with 3 companies.

1st problem: The business opportunities are difficult to catch recently because of global competitions and the amount of each order earned is becoming smaller.

The suggestion is to adapt multiple cross border e-commerce portals on budgets and “Software key activities” for decision making on global market researches and customer preferences, and so on.

2nd problem: It is the higher cost of logistics. Logistics cost is one item of competitive advantages and also one main concerns of cross border e-commerce buyers.

The suggestion is to adapt “group buying” strategy for moving products into oversea warehouse before getting orders. Moreover, use Big Data Analysis and artificial intelligence (AI) technology to calculate exact oversea inventories. And the material of packaging needs simple and light ones.

3rd problem is lack of “Online Trust”. Inquiry, negotiation on price and after sale customer service all depend on sales representatives with English communication. The mutual trust is difficult to build upon e-mail, social media APP and long distant telephone. The problems could be cultural differences, different language, and so on.

The suggestion for this problem is localization strategy, to systematically recruit and train the talents who are familiar with the culture, products and markets. So before enter the specific market, local market research is necessary. And it should use the third-party money transfer security services. Moreover, face to face Trade Show periodically also help to .

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Longitudinal Analysis of Economic Clusters: A Novel Methodology and Application of UK Regions

(Abstract Only)

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ABSTRACT

Standard Industrial Classification (SIC) classify organizations based on their business activities. However, choosing appropriate SIC code that represents an organization's business activities in a challenging task. In the UK, there are almost 100 categories each having several subcategories of predefined business activities designed by experts. However, such scheme cannot cater for emerging business needs while some organizations cannot be easily defined by a single SIC code, due to the complexity of their business nature. Similarly, if a company expands or changes its operation during the year, a new SIC code needs to be assigned. This results in organizations having difficulties picking representative SIC code to use in defining their business activities. In this paper, we propose a dynamic framework that can automatically group organizations based on their business activities. Our framework leverages techniques from topic modelling. Result shows that our proposed framework can automatically adapt to changing business needs and cluster organizations effectively.

Keywords: Big data analytics, longitudinal analysis, standard industrial classification, topic modelling.

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INTRODUCTION

Accurately classifying industries into clusters based on their business activities is essential in order to provide valid statistical information and to quantify the impact of industry structures on innovations and investments. These classification systems provide insight into the economy and trade and it enlightens policy makers on current industrial activities. In the UK, the standard industrial classification (SIC) is used for classifying economic activities (Smith & James, 2017).

SIC consist of 99 categories and several subcategories used to define the business activities of organizations in the UK. The design of the SIC system reflected the way industry structures were understood by policy makers at the time creation (Porter, 1981). The duty of the policy makers is to promote equilibrium in the economy. Therefore, the SIC system is designed based on the past business activities of organizations. For example, within the "Agriculture, Forestry and Fishing" group, there are 40 different SIC codes ranging from growing of cereals to freshwater aquaculture.

However, such classification schemes do not adapt to the evolving changes in business activities. For example, changes in the standard industrial classification have occurred approximately every 10-15 years in the UK. Similarly, when such changes occur, they require large amounts of resources to implement and can create disruption in time series (Brook, Matthews, & Darke, 2011).

LITERATURE REVIEW

In the UK, SIC has been revised seven times since 1948. These revisions, with the latest in 2007, have failed to capture recent business activities (Hughes & Brook, 2009). Business activities not explicitly captured by the classification codes are grouped into the "other" categories (e.g other mining and quarrying category) (Hrazdil & Zhang, 2012). Similarly, the revision of SIC has brought about differences in codes across databases, thereby causing inconsistencies and failure to identify industries that have similar operating characteristics (Hrazdil, Trottier, & Zhang, 2014).

Also, products and services have become more complex as a result of changes in innovation and technology (Dalziel, 2007). These technological changes may affect production processes and appropriate classifications because products and services depend on a wide range of supporting products and services to function fully.

Lastly, the development of the SIC system indicates the perception of the industry structure as understood by the experts as at the time of its creation (Hrazdil, Trottier, & Zhang, 2013). This creates an inflexible and rigid classification scheme as opposed to a dynamic scheme that can instantly capture emerging business activities.

METHODOLOGY

To solve the above problems, we propose a dynamic framework based on techniques from topic modelling that is robust to emerging business needs and can automatically assign a cluster to an industry based on their business activities. Topic modelling is a method of discovering group of words also known as topic from a corpus. It is a type of statistical model can be used to identify recurring patterns of words from text and discover hidden semantic structures embedded in text. Topic modeling techniques have proven to be effective in various natural language modelling tasks such as semantic mining and discovery of latent topics in documents. In topic modelling, a topic is defined as a list of co-occurring words with statistical significance. A document in our case is the textual description of firm's activities and corpus is the collection of documents. Techniques used in topic modelling includes Explicit Semantic Analysis (ESA) (Gabrilovich, Markovitch, & others, 2007), Latent semantic Analysis (LSA) (Deerwester, Dumais, Furnas, Landauer, & Harshman, 1990), Probabilistic Latent Semantic Analysis (pLSA) (Hofmann, 2001), Latent Dirichlet Allocation (LDA) (Blei, Ng, & Jordan, 2003) and Hierarchical Dirichlet process (HDP) (Teh, Jordan, Beal, & Blei, 2005). Of all the above techniques used for topic modelling, Latent Dirichlet Allocation (LDA) is most suitable for our task and performs better than others.

Therefore, our framework utilizes Latent Dirichlet Allocation (LDA), a generative statistical model that can automatically extract topics from documents (Blei, Ng, & Jordan, 2003). In LDA, each cluster, also known as a topic, consists of a series of words, each with a weight that indicates the importance of the word in the cluster. The aim of LDA is to infer latent topics from the corpus. LDA assigns a set of topics for each document with dirichlet distribution and computes a probability over the words in the entire corpus. Then for each document, LDA calculates the probability of the words in the documents belonging to the mixture of a word set of the topics.

Let \mathcal{C} be a corpus consisting of D documents (description of firm's activities) and T be the number of topics. Each document $d \in D$ consists of k words $\mathbf{w} = (w_1, w_2, \dots, w_k)$. For each document $d \in \{1, \dots, D\}$, we choose a multinomial distribution θ sampled from a Dirichlet distribution with α . Similarly, for each topic $t_n \in \{1, \dots, T\}$, we choose a multinomial distribution φ sampled from a Dirichlet distribution with β . Then each word w_k in document d is sampled conditioned on the t_n th topic from the multinomial distribution φ .

In the generative process described above, α and β are hyper parameters, θ and φ are latent variables and words w_k in the document are the observed variables. We compute the probability of the document over the corpus and infer latent variable and hyper parameters by:

$$p(\mathcal{C} | \alpha, \beta) = \prod_{d=1}^D \int p(\theta | \alpha) \left(\prod_{k=1}^k \sum_{t_n=1}^T p(t_n | \theta) p(w_k | t_n, \beta) \right) d\theta \quad (1)$$

Where $p(t_n | \theta)$ is a multinomial characterized by θ , $p(w_k | t_n, \beta)$ is the a multinomial over the words and $p(\theta | \alpha)$ is the Dirichlet. As shown in the equation above, the Dirichlet is sampled for each document and topics are sampled repeatedly within the document. Since LDA treats documents as a mixture of topics (where a topic is the probability distribution over the set of words), the Dirichlet $p(\theta | \alpha)$ gives the mixture weight.

Our dataset consists of information extracted from the websites of over 14,000 companies from 2000 to 2019 in the UK across six regions (Guernsey, Ireland, Northern Ireland, Wales, East London and Scotland). This information includes the description of the firm's activities, number of employees, turnover, SIC codes and address. Precisely, the description of the firm's activities was treated as our text corpus for performing the analysis. The aim of our analysis is to group companies into clusters based on their business activities. To estimate the parameters of our LDA model and to infer the distribution of topic and words, we used Variational Bayes (VB) inference. VB uses parametric approximation to the posterior distribution of parameters α and β , and latent variables θ and φ . VB allows for faster convergence and iteration can be computed faster than Gibbs sampling method. Based on experiments, we set $\beta = 0.01$ while we let α automatically learn asymmetric prior from the corpus.

We split the textual description of the firm's activities into sentences and sentences into words. We performed stemming, lemmatization, and removed punctuation and stop words. To extract reasonable topics, our model considers the frequency of words within a topic and also across topics to prevent certain words appearing in all the topics. We performed both cross-sectional analysis and longitudinal analysis. For our cross-sectional analysis, we cluster companies based on their business activities within their regions. We determined the optimal number of clusters based on the data about that region. For the longitudinal analysis, we consider a triplet consisting of region, quarter and year. For each triplet, we performed coherence analysis to determine the optimal number of clusters for the business activities. We use the above triplet as input into our LDA model to show the evolution of clusters for each <region, quarter, year> triplet.

RESULT

Our preliminary result shows that our proposed framework can effectively cluster new business activities and adapt the number of clusters dynamically based on the textual description of the business need. Secondly, the implementation of our framework provides a low-cost solution that can detect homogeneity in business activities. Lastly, our result shows that our model reduces within-class heterogeneity and is robust to changes in technology and business needs.

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Marketing strategy of organic agricultural products on e-commerce platforms

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ABSTRACT

With the strong growth of China economy in the dozens of years, there has been increasing demand of products and services of high quality from Chinese consumers with rising salary and disposable income. Despite recent concerns of economy slow-down and softening currency, Chinese consumer confidence still keep upbeat and resilient with strong interest of shifting spending to premium segment. This trend is especially phenomenal when it comes to spending on agricultural products. Chinese consumers tend to choose products with clear and credible indication of Non-GMO and organic label. However, despite of strong demand, it has been a long existing challenge of insufficient supply of organic products in China agricultural market without a well-guarded and reliable system of quality assurance. With E-Commerce platform, a new advent of technology that bridges supply and demand of niche and emerging segment, more opportunities are exposed to both consumers and suppliers in increasing the outreach of organic agricultural products and consumers willing to pay extra. This study analyses pricing, branding and distribution strategy for organic agricultural products and devises a portfolio of integrative marketing strategies and tactics that is applicable in the new era of digital marketing, built from the case of JD.com, one of the largest B2C E-commerce platform in China.

Keywords: organic products, e-commerce, digital marketing

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