

The Impact of IT Capability and E-Business on the Supply Chain Performance

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ABSTRACT

This research has developed an analytical framework based on resource-based theory. It intends to find out the impact of different attributes on supply chain performance and financial performance under different IT capabilities and application degrees. The hypothesis test model incorporating five measuring variables is conducted; they are strategy of e-business, application degree of e-business, information technology capability, supply chain performance and financial performance. The results indicate that e-business strategy will affect the application degree for either high-tech industry or traditional industry; and higher IT capability will make the application degree impact on supply chain performance more significant while financial performance is not obviously activated. E-business should be a strategic policy. The managerial full support and involvement, cautious selection of new operational strategy, as well as the integration of e-business process and information, will make IT application, e-business process and readiness collaborate closely, so as to create business value and promote operational performance of supply chain.

Keywords: application degree of e-business, information technology capability, supply chain performance, resource-based theory

1. RESEARCH BACKGROUND AND MOTIVE

Coming along with the knowledge economy, the trend of globalization, digitization unceasingly challenges existed management concepts. The development of e-business has become the primary consideration to be survived. Information technology (IT) is applied to promote operational efficiency in the past. Nowadays, due to the maturity of internet technology, it has been applied to commercial management, and to integrate the information system. The development of e-business will undoubtedly induce further revolution of supply chain (SC). The construction of business to business (B to B) can especially improve the efficiency and circulation speed of information, enhance the effective management on supply chain, and decrease the risk and pressure of stock.

The rapid change of IT speeds up the footstep of e-business and the integration of business process across different enterprises. Upstream and downstream over the supply chain system can promptly and correctly link their logistic flow, information flow and cash flow together. The efficiency and effectiveness of whole supply chain is upgraded, and the demand uncertainty is decreased. Supply chain management can therefore be greatly improved. However, whether the competence of e-business can be improved depends on its ownership of flexible information technology. Only those who own superior information capability can realize the competitive advantage in the e-environment.

The application of information system has positive influence on supply chain management in many companies (Barua *et al.*, 2001). Most of the literatures focused on the theoretical study, and little of them

discussed in empirical way. This paper will measure the IT capability of enterprise by using resource-based theory. The impact of e-business on supply chain performance and financial performance will be analyzed under different IT levels and corporate features, in order to make concrete conclusion and suggestion. If the enterprise can integrate the inner and outer management information system while constructing e-business, the supply chain performance and competitive strength can be greatly improved.

The major objective of this paper is to investigate the impact of e-business on supply chain performance and financial performance for manufacturers under different IT levels and corporations.

2. EB STRATEGY AND IT CAPABILITY

2.1 E-business and Strategy

E-business is the generic name of business models and processes accomplished by internet technology, it focuses on the improvement of long term business performance (Simchi-Levi *et al.*, 2000). E-commerce corresponds to the ability to operate business in electronic way. So e-commerce is only one part of e-business; internet is the driving force of corporate re-engineering. E-business emphasizes more on the development of extended business, that is, business interior, business to customer (B to C) as well as business to business (B to B) transactions.

The applications of e-business onto supply chain have many different configurations. Lee *et al.* (2002) divided e-business applications into e-commerce, e-procurement and e-collaboration.

- (1) E-commerce: Assisting the supply chain partners inside the network system can quickly confirm or feedback via internet to fulfill customer's requirement.
- (2) E-procurement: Corporations can access direct or indirect materials, handle value-added services such as transportation, warehousing, payment mechanism, quality assurance and documentation management etc. via on-line mechanism.
- (3) E-collaboration: Accelerate the coordination and cooperation of various transaction activities among the supply chain partners including all suppliers and customers exploiting the internet.

Johnson *et al.* (2002) defined e-business as the marriage between the integration of internet and supply chain. This marriage transformed many processes within the supply chain from procurement to customer management and product design. The enterprise must integrate the information system with their developed e-business capability. The effective integration can systematically utilize all resources and take advantage of leverage function. Grandon and Pearson (2003) identified three factors to be influential concerned with the perception of strategic value in other information technologies: operational support, managerial productivity, and strategic decision aid.

Barua *et al.* (2001) suggested a e-business value model which included e-business drivers, operational excellence measures and financial measures as measuring indexes. E-business drivers encompassed three areas: e-business processes for customers and suppliers; IT applications for customers, suppliers and internal operations (all of them must be integrated); and the e-business readiness of customers and suppliers. They stated that in trying to bring about e-business transformation, companies generally focused too much of their attention on technology. But systems didn't work in a vacuum, and senior managers must recognize the complementary nature of technology, business processes and e-business readiness throughout the value chain.

2.2 IT capability

Mata *et al.* (1995) stated that managerial IT skills were rare and firm-specific which might be the source of sustained competitive advantage. The resource-based view assumed firms possessed four kinds of resources that differentiated it from other firms; that is, value, rareness, imperfect imitability and insubstitutability (Barney, 1991). The dynamic capabilities were defined as the firm's ability to integrate, build and reconfigure internal and external competences to create profit and achieve competitive strength (Teece, Rumelt, Dosi and Winter, 1994; Teece, Pisano and Shuen, 1997).

Broadbent and Weill (1997) suggested IT infrastructure should include technical IT infrastructure and human IT infrastructure. Broadbent, Weill and St. Clair (1999)

pointed out the organization should be equipped with physical IT infrastructure such as hardware, software, communication technology, data base, application etc., as well as human IT infrastructure such as technique, experience, ability and knowledge etc. Via the combination of technology and human, the shared IT service can be constructed to provide services, such as networking, data access and exchange, business process support etc., to decrease operational cost and improve the performance and competence of organization.

Byrd & Turner (2000) summarized IT capabilities into eight dimensions, they are IT connectivity, applications functionality, IT compatibility, data transparency, technology management, business knowledge, management knowledge and technical knowledge.

As for the supply chain performance, Frohlich (2002) indicated that operational performance was based on faster delivery times, reduced transaction costs, and enhanced inventory turnover related to web-based integration. Operational excellence measures included the percentage of online business, the percentage of online procurement, the percentage of online customer-service provided online and order delivery time. Financial measures included revenue per employee, gross profit margin and return on assets.

3. DESIGN QUESTIONNAIRE SURVEY

3.1 Survey Structure

The structure of this survey includes five factors as illustrated in Figure 1. IT capability and corporate feature are treated as moderating variables in order to study whether they will affect the relationship between e-business and SC performance. The relationship between hypotheses and various variables will be validated empirically in this paper.

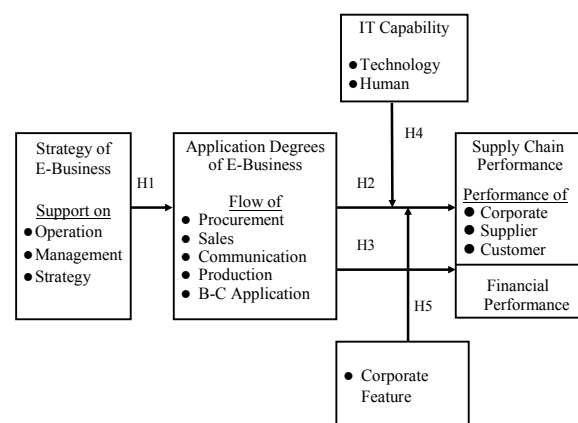


Figure 1 Research structure

Synthesizing the relevant literatures, we generate five hypotheses:

H1: Application degree of e-business is positively related to strategy (goal) of e-business.

H2: Supply chain performance is positively related to application degree of e-business.

H2a: Operational performance is positively related to application degree of e-business.

H2b: Supplier performance is positively related to application degree of e-business.

H2c: Customer (buyer) performance is positively related to application degree of e-business.

H3: Financial performance is positively related to application degree of e-business.

H3a: Gross profit margin is positively related to application degree of e-business.

H3b: Net profit margin is positively related to application degree of e-business.

H4: The impact of application degree of e-business on supply chain performance is significant dependent on IT capability.

H4a: The impact of application degree of e-business on operational performance is significant dependent on IT capability.

H4b: The impact of application degree of e-business on supplier performance is significant dependent on IT capability.

H4c: The impact of application degree of e-business on customer (buyer) performance is significant dependent on IT capability.

H5: The impact of application degree of e-business on supply chain performance is significant dependent on corporate feature.

H5a: The impact of application degree of e-business on supply chain performance is significant dependent on the industrial type.

H5b: The impact of application degree of e-business on supply chain performance is significant dependent on organization scale.

3.2 Questionnaire Design

There are five factors considered in our survey sheet, they are strategy of e-business, degree of e-business, information technology capability, supply chain performance, financial performance. Five factors contained in each characteristic are three, five, seven, twelve (4, 4, 4) and two items in respective. Survey data is measured in ordinal scale (1, 2, 3 ...) according to Likert's five grading scales (e.g. 1 represents "contribute no benefit", 5 represents "contribute full benefit"). The financial performance is mainly obtained from TEJ data base.

4. RESULT ANALYSIS AND DISCUSSION

4.1 Data Collection

The investigation survey sheet is designed originally on literature review and revised through experts interview, so that the contents effectiveness can be well assured. The survey population comes from Taiwan Top 1000 Manufactures, as well as the corporate joined AB E-Business Program (An e-business promotion program focusing on procurement and customer order processing that is supported by Taiwan, China). Survey data is randomly sampled and collected through e-mail and paper-mail, we issue 830 samples and 105 effective sheets (12.72%) are collected.

The received 105 effective investigation sheets covered different corporate features, with which can be used for analysis in effectiveness. The statistical software tool SPSS for Windows 10.0 is used for corresponding data analysis, it is also applied for variables validity and reliability assured.

Confidence analysis assures the consistency and stability of the measuring result. Confidence analysis takes the functionality to measure the degrees of data confidence within each factor and its related attributes; if the confidence Cronbach α value is greater than 0.7 then the investigated data is assumed to be sufficient confidence. In general, the Cronbach α value for each factor is greater than 0.8.

4.2 Declarative Statistics

The surveyed manufacturers are categorized into three groups (high-tech co. x 52; traditional co. x 43; foreign co. x 11). Declarative data analysis is applied based on 5 factors and its related attributes in correspondence to three groups of corporate organization, with which it can show the difference among them (Table 1).

In general, the foreign corporations (all of them are electronics industry) invest more in e-business and IT than local industries do. The strategies of e-business are mostly for the purpose of operational support. It implies most of the enterprises perceive e-business as the tool for customer service improvement, distribution channel development and competitiveness enhancement. The application degrees of e-business on procurement and sales flow are lower, because they involve not only the enterprise itself, but also the integration with upstream and downstream enterprises. The implementation is more difficult than other items that make their application degrees the lowest. Currently, the application of e-business is mainly focused on internal communication flow, such as using e-mail to transmit information. The IT capability of foreign electronic corporations is better than that of local high-tech corporations, while the later surpasses that of local traditional industries. As for the performance, information sharing and management perform better.

Table 1 The comparison among strategy, application degree, IT capability and SC performance

Main-factor	Sub-factor	High-tech industry	Traditional industry	Foreign corporation
Strategy	Operational support	4.109	4.092	4.364
	Managerial productivity	4.020	4.006	4.409
	Strategic decision support	3.993	3.983	4.242
Application degree	Procurement flow	2.439	2.607	3.299
	Sales flow	2.554	2.589	3.082
	Internal communication flow support	3.758	3.513	4.136
	Production process	3.119	2.875	4.068
	Business process of B to C	3.177	3.258	3.879
IT Capability	IT connectivity	3.621	3.613	4.136
	Application functionality	3.454	3.425	4.227
	IT compatibility	3.566	3.500	4.046
	Data transparency	3.347	3.331	3.750
	Business operation knowledge	3.648	3.575	3.925
	Management related knowledge	3.517	3.508	3.667
	Professional IT knowledge	3.862	3.546	3.950
Corporate operational performance	Order fulfillment management	3.728	3.872	4.000
	Information flow management	3.898	3.910	4.350
	Procurement management	3.687	3.932	4.000
	Inventory management	3.602	3.667	3.700
Supplier performance	Intensify information sharing	3.510	3.795	4.000
	Shorten delivery lead time	3.388	3.718	3.800
	Increase delivery reliability and service level	3.347	3.590	3.800
	Decrease delivery cost of supplier	3.204	3.590	3.400
Customer (buyer) performance	Intensify information sharing	3.551	3.641	3.700
	Improve customer service level	3.571	3.692	4.000
	Increase customer satisfaction	3.571	3.692	3.800
	Upgrade customer royalty	3.347	3.615	3.600

4.3 Correlation Analysis

Pearson analysis is used to review whether the paired comparative data is significant difference, eight attributes are considered in Pearson analysis. Parts of the results can be summarized as below.

- (1) Strategy and application degree of e-business have positive correlation ($r=0.461$; $p \leq 0.01$).
- (2) IT application degree and supply chain performance (corporate operational performance, supplier performance and buyer performance) have positive correlation ($r=0.538$).
- (3) IT capability and supply chain performance has positive correlation ($r=0.578$; $p \leq 0.001$).
- (4) Application degree and financial performance has no significant correlation.

4.4 Regression Model Analysis

- (1) The relationship among strategy, application degree and supply chain performance
The regression model is used further to validate the hypotheses and clarify their linear casual relationships. Table 2 shows that the strategy will affect the application degree of e-business, that is, the more the

enterprise learn what benefit e-business will bring for them, the eager they will construct the operation management model of e-business. Hypothesis 1 is therefore supported by this result. The higher application degree will induce higher supply chain performance that supports Hypothesis 2. Based on the correlation analysis and regression model, the application degree and financial performance has no significant relationship, that is, Hypothesis 3 is invalid. The construction of e-environment and introduction of IT require enormous investment. Successful implementation of e-business also needs the integrated support coming from technology, process and human. The operational performance can be improved in short term, but the financial performance needs long term efforts and the integration of systems.

- (2) The impact of application degree on supply chain performance under different IT capabilities
Based on Hypothesis 4: IT capability will affect the relationship between application degree and supply chain performance, we sort surveyed corporations into two groups (higher IT capability and lower IT capability) to analyze the impact of application degree on supply chain performance. Hypothesis 4 is supported based on the analysis of Table 3.

Table 2 The regression model among strategy, application degree and supply chain performance

Dependant variable	Prediction variable	R ²	β	t value	p value	Hypothesis
Application degree	Strategy	0.212	0.461	5.142	0.000***	H1
Order fulfillment management	Application degree	0.260	0.510	5.803	0.000***	H2a-1
Information flow management	Application degree	0.189	0.435	4.729	0.000***	H2a-2
Procurement management	Application degree	0.206	0.454	4.990	0.000***	H2a-3
Inventory management	Application degree	0.174	0.417	4.501	0.000***	H2a-4
Supplier performance	Application degree	0.359	0.599	7.328	0.000***	H2b
Customer (buyer) performance	Application degree	0.332	0.576	6.906	0.000***	H2c
Gross profit margin	Application degree	0.003	0.055	0.394	0.695	H3a
Net profit margin	Application degree	0.035	0.188	1.350	0.183	H3b

Remark: *** Significant level $p < 0.001$, ** Significant level $p < 0.01$, * Significant level $p < 0.05$

Table 3 The regression model between supply chain performance and application degree under different IT capability

Dependant variable	IT capability	Prediction variable	R ²	β	t value	p value
Operational performance	High	Application degree	0.107	0.327	2.423	0.019*
	Low		0.095	0.308	2.173	0.035*
Supplier performance	High	Application degree	0.274	0.523	4.297	0.000***
	Low		0.162	0.403	2.954	0.005**
Buyer performance	High	Application degree	0.323	0.568	4.836	0.000***
	Low		0.109	0.330	2.341	0.024*

Remark: *** Significant level $p < 0.001$, ** Significant level $p < 0.01$, * Significant level $p < 0.05$

(3) The impact of application degree on supply chain performance under different corporate features

Hypothesis 5a proposes that the industrial type will affect the impact of application degree on supply chain performance. Based on the linear regression model, we observe that application degree has significant impact on supply chain performance, and IT capability will affect the supply chain performance no matter what industry group the corporation is belonging to. This means that H5a is not accepted.

Hypothesis 5b suggests that the organization scale will affect the impact of application degree on supply chain performance. The organization scale is divided into two groups based on the employee population – 1 stands for the population is greater than the mean value while 2 smaller than it. The result shows that application degree has significant correlation with supply chain performance in both groups, which means H5b is not accepted too.

4.5 Discussion

The validation of the hypotheses proves that all hypotheses are true except H3 (the financial performance and application degrees of e-business have no significant correlation.) and H5 (the impact of application degree of e-business on supply chain performance is not significant dependent on corporate feature.)

5. CONCLUSION

This paper investigates the relationship among strategy of e-business, application degree of e-business, IT capability, corporate feature, supply chain performance and financial performance. The results obtained from the analysis can be summarized as below:

(1) Application degree of e-business is positively related to strategy of e-business.

There is no doubt that implementation of E-Business will increase the competitiveness, save the cost and reduce the risk. However, the implementation of E-Business involves the strategic consideration of the business process. Top management must clearly figure out its process re-engineering project, set unique operation model and definite target for whole supply chain system, so that the competitive model of e-business can be constructed.

(2) Supply performance is positively related to application degree of e-business.

The higher application degree of e-business will bring about better supply chain performance. E-business is becoming the key success factor of competitive strength in the global environment. The brand new operation model created by e-business can shorten the unforeseen distance with partner, and control the stock status of upstream and downstream firms whenever it is necessary. The immediate, flexible and speedy operation ability earns the competitive strength for enterprise in the global fast changing environment.

(3) Financial performance is not significantly related to application degree of e-business.

The promotion of e-business should be sustained to improve the operational performance of business, until then, the profit margin can be increased further. Besides, the introduction of e-business and related information system require vast investment. Only long term continuous implementation of e-business can actually improve the financial performance.

(4) The impact of application degree on supply chain performance is significantly dependent on IT capability level.

E-business is the utmost application of IT. While applying e-business to business model and flow, a company must integrate it with its information system. Only the successful integration can make all resources emerge their multiplicative effect.

(5) The impact of application degree of e-business on supply chain performance is significantly dependent on industrial type.

A company should be capable to adapt itself to the dynamic fast changing environment. In general, the high-tech industry has capital-intensive and flexible information system, so the implementation of e-business is easier than traditional industry. But the encouragement from government has also made many large-scale traditional industries introduce e-business to improve their supply chain performance.

Most information industry in Taiwan is OEM or ODM factory. The short life time of product, the dispersion of suppliers, the fierce competition in the market as well as many uncertain factors might disturb the supply chain performance while promoting e-business. The market uncertainty in tradition industry is much less than high-tech industry, so the successful implementation of e-business will greatly improve its supply chain performance.

(6) The impact of application degree of e-business on supply chain performance is significantly dependent on organization scale.

E-business implementation is long-term strategic change, hence, the acceptance coming from employees plays an important role in the change of process. Top management must be well aware of e-business implementation and steer the process change with suitable promotion methods based on employees' traits. The operational efficiency of business process can therefore be improved.

REFERENCES

- [1] Barney, J.B., "Firm Resources and Sustained Competitive Advantage", *Journal of Management*, 17(1): 99-120, 1991.
- [2] Barua, Anitesh, Prabhudev Konana, Andrew B Whinston and Fang Yin, "Driving E-business Excellence", *MIT Sloan Management Review*, 43(1): 36-44, Fall 2001.
- [3] Broadbent, M., and P. Weill, "Management by Maxim: How Business and IT Managers Can Create IT Infrastructures", *Sloan Management Review*, 38(3): 77-92, 1997.
- [4] Broadbent, M., P. Weill and D. St. Clair, "The Implications of Information Technology Infrastructure for Business Process Redesign", *MIS Quarterly*, 23(2): 159-182, 1999.
- [5] Byrd, T. A. and D.E. Turner, "Measuring the Flexibility of Information Technology Infrastructure: Exploratory Analysis of a Construct", *Journal of Management Information Systems*, 17(1): 167-208, Summer 2000.
- [6] Frohlich, Markham T., "E-integration in the Supply Chain: Barriers and Performance", *Decision Sciences*, 33(4): 537-556, Fall 2002.
- [7] Grandon, Elizabeth and John M. Pearson, "Strategic Value and Adoption of Electronic Commerce: An Empirical Study of Chilean Small and Medium Business", *Journal of Global Information Technology Management*, 6(3): 22-43, 2003.
- [8] Johnson, M Eric; Seungjin Whang, "E-business and Supply Chain Management: An Overview and Framework", *Production and Operations Management*, 11(4): 413-423, 2002.
- [9] Lee, H. L., P. Padmanabhan, and S. Whang, "Supply Chain Integration over the Internet", *Supply Chain Management: Models, Applications, and Research Directions*, 2002.
- [10] Mata, Francisco J., William L. Fuerst and Jay B. Barney, "Information Technology and Sustained Competitive Advantage: A Resources-Based Analysis", *MIS Quarterly*, 19(4): 487-505, Dec 1995.
- [11] Simchi-Lei, D., P. Kaminsky and E. Simchi-Levi, *Designing and Managing the Supply Chain – Concepts, Strategies, and Case Studies*, McGraw Hill, 2000.
- [12] Teece, D.J., R. Rumelt, G. Dosi and S. Winter, "Understanding Corporate Coherence: Theory and Evidence", *Journal of Economic Behavior and Organization*, 23(1): 1-30, 1994.
- [13] Teece, D.J., G. Pisano and A. Shuen, "Dynamic Capabilities and Strategic Management", *Strategic Management Journal*, 18(7): 509-533, 1997.