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Characteristics of product/service process and customer needs of geographical accessibility in electronic commerce

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Keywords *Electronic commerce, Service industries*

Abstract *The necessity of geographical accessibility between service provider and the customer has been essential for face-to-face contact in many service industries. However, the emergence of electronic commerce (EC) and new technologies has altered the concept of location and geographical accessibility of service industries in a traditional economy. This study developed factors representing characteristics of product/service processes and verified that those factors are significantly related to customer needs of geographical accessibility in the transactions of EC. In addition, it investigated the relationships with the reasons for customer needs of geographical accessibility. Data for analyses were collected through customer surveys and statistically analyzed through exploratory factor analysis, multiple regression analysis, and canonical correlation analysis.*

1. Introduction

The need for geographical accessibility between service provider and customer is a basic characteristic of traditional service industries resulting from the need for face-to-face contact in transactions. However, electronic commerce (EC) and new technologies have changed the concept of geographical accessibility by expanding the reach of market areas. More specifically, many service industries such as retailing, tourism, education, consulting services, and financial services have the opportunity to expand the reach of market areas from the EC environment due to the unique characteristics of “intangibility” in services. In such transactions, many of the service processes can be substituted efficiently by EC applications, increasing customer convenience.

However, overcoming the barriers of distance from using EC will be largely dependent on the detailed characteristics of product/service processes. Closely related to characteristics of product/service processes, customers are likely to prefer services delivered from an approachable point arising from the need for



face-to-face interactions, maintenance of service quality, and avoidance of perceived risk in delivery. Thereby focusing on customer needs of geographical accessibility in EC, this study aims to contribute to the understanding of the effects of EC on service industries.

Meeting customer needs of geographical accessibility is a critical factor in establishing EC operation strategies for customer contact and service delivery (Boyer *et al.*, 2002), customer support and logistics (Hallowell, 2000), and distribution channel strategies and network design (Mols, 1999). In this study, we examined the characteristics of product/service processes and analyzed its relationships with customer needs of geographical accessibility. Focusing on the characteristics of product/service processes can provide strategic insights generally adaptable to any products or services in understanding customer needs of geographical accessibility in EC.

In this study, a written survey was conducted on customer groups to measure their perceptions on the characteristics of product/service processes and customer needs of geographical accessibility. Collected data were analyzed with the application of the following statistical methods – exploratory factor analysis, multiple regression analysis, and canonical correlation analysis. The rest of the paper is organized into four sections. The second section provides an overview of the representative characteristics of product/service processes and customer needs of geographical accessibility. In the third section, a description of the data and methods used in the analysis are presented, and the resulting factors identified by statistical method are reported. Also, the results of the analysis on the relationships between the product/service process characteristics and customer needs of geographical accessibility are explained in this section. Next, in the fourth section, the overall results are summarized and implications of this research are discussed. And finally, concluding remarks are provided in the fifth section.

2. Background and research propositions

In this section, the concept of customer needs of geographical accessibility is introduced and the characteristics of product/service processes are reviewed concerning EC operations. From the review, representative characteristics of product/service processes are developed and research propositions are then proposed concerning the relationships with customer needs of geographical accessibility. In addition, factors concerning the reasons behind customer needs of geographical accessibility are explored for further study.

2.1 Customer needs of geographical accessibility in EC

The retail location and distribution network have been regarded as strategic decisions in targeting customers, market occupation, and creating a store portfolio in aggregate terms (Hernandez and Bennison, 2000; Ghemawat, 2001; Greenland, 1995; Schmenner, 1994; Dennis *et al.*, 2002; Mahajan *et al.*, 1985).

However, EC and new technologies have changed the geographic pattern and density of traditional branch networks as well as customer needs of geographical accessibility by overcoming barriers of geographical distance in transactions (Mols, 1999; Boyer *et al.*, 2002). For example, the increasing use of automated teller machines (ATMs) and management activities have physically transformed networks, greatly reducing branch numbers, drastically changing the appearance of physical networks and the function of branches, as well as reorganizing the overall geographic pattern of outlets for financial services (Greenland, 1995). Electronic commerce provides a new environment that brings definitive changes in customer needs of geographical accessibility by extending the service area and expanding market scope.

However, due to the “inseparability” of the service activity, which means that many services require the attendance of a direct recipient (people or things) in the service production process, many services call for personal interactions between the service provider and customer. Therefore, geographical accessibility should be still regarded as a critical variable affecting EC operations in a wide range of services (Boyer *et al.*, 2002; Hallowell, 2000; Mols, 1999), although its importance has been reduced with the advent of EC applications and related technologies. In particular, customer perceptions to the needs of geographical accessibility in EC will be critical since it may be closely tied to customer purchasing behavior.

2.2 Characteristics of product/service processes in EC

Generally, in EC, the characteristics of multi-channel services need to be considered due to the many services that are provided through on-line and off-line cooperation. Therefore, the characteristics of product/service processes identified in the traditional economy need to be extended to those multi-channel services on-line and off-line. In this study, six representative characteristics of product/service processes in EC are identified. The relationships between representative characteristics are explained in Figure 1. Tangibility and intangibility are generally related to the characteristics of product, while others such as “proportion of on-line substitution for services”, “need for on-line interaction”, “need for on-line customization”, “need for off-line interaction”, and “need for on-line customization” are related to the characteristics of service processes. The proportion of on-line substitution for services is related to the proportion of on-line service processes out of overall service processes including off-line. In addition, the need for interaction and customization within each channel is concerned with the degree of those characteristics required in each service channel.

Degree of product intangibility. Tangibility and intangibility are two major characteristics that are frequently used to describe a product or service (Rayport and Sviokla, 1995; Peterson *et al.*, 1997; Koppius, 1999; Poon and Joseph, 2000; Phau and Poon, 2000), based on the characteristics of EC in which

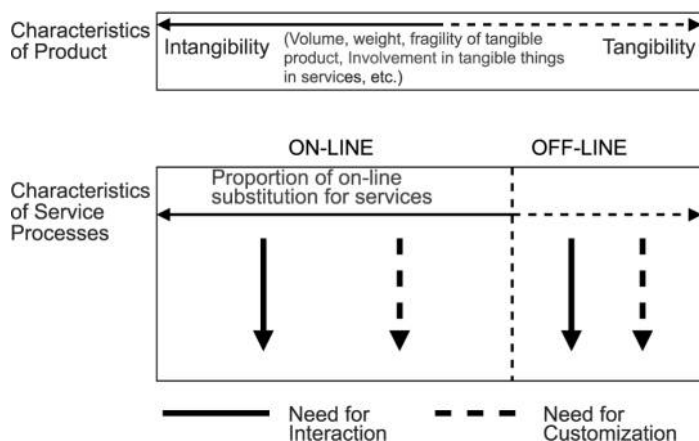


Figure 1.
Representative
characteristics of
product/service process
in EC

transactions are conducted on an electronic network. Tangible goods require the cooperation of off-line functions to be delivered directly to customers. In this context, intangible products are more suitable for EC applications (Rayport and Sviokla, 1995).

Generally, tangibility and intangibility of a product or service is classified into two categories of a nominal scale, 0 or 1, representing tangible or intangible. However, the need to measure these factors as continuous variables in terms of the degree of tangibility or intangibility (from low to high tangibility or intangibility) is required to reflect the characteristics of volume, weight, product fragility of a physical product, and the degree of involvement in physical items in the transaction of services. For example, books and CDs can be sold over a broad market segment due to the characteristics of low tangibility along with small size and low fragility, although such products are tangible. On the other hand, a physical product of large volume or very fragile goods needs to be measured as highly tangible. Similarly, service products that are involved in physical things, such as equipment repair, need to be measured as more tangible than pure intangible services. In this study, these two product characteristics of the degree of tangibility and intangibility were included to the definition of “degree of product intangibility”, emphasizing the importance of the characteristics of “intangibility” in EC environment. Therefore, for example, high product tangibility was replaced with low product intangibility in our study.

From these characteristics, a research question arises concerning customer needs of geographical accessibility as determined by the degree of “intangibility” in EC.

- P1.* The increase in the degree of intangibility will contribute to the decrease of customer needs of geographical accessibility in EC.

Proportion of on-line substitution for services. For EC operations, a new characteristic of the proportion of on-line substitution for services needs to be considered. This characteristic is critical for understanding two-channel (on-line and off-line) operations in EC services. The scope of whole service processes and the proportion of on-line substitution for that service may be dependent on the characteristics of product/service processes. Specifically, the proportion of on-line substitution to which customers perceive in transactions of a highly tangible product will be lower than the cases of less tangible products. Likewise, the case will be similar for the transaction of services, although they are generally assumed to have characteristics of intangibility. For example, tangible actions (Lovelock, 1983) such as restaurants, health care, and industrial equipment repair are not fully substituted on-line, but rather require the physical presence or contact of a direct recipient (people or thing). The same is expected for intangible services where high face-to-face interactions are inevitably accompanied (e.g. professional management consulting). On the other hand, intangible actions such as education, broadcasting, and information services can be fully substituted on-line. These characteristics are related to the research question on the effect of “the proportion of on-line substitution for services” on customer needs of geographical accessibility in EC, thereby leading to the following research proposition:

- P2. The proportion of on-line substitution for services will contribute to the decrease of customer needs of geographical accessibility in EC.

Need for on-line interaction. Interaction, or customer contact, is a factor that has been adopted as a critical variable in many previous studies (Chase, 1978; Maister and Lovelock, 1982; Schmenner, 1986; Mersha, 1990; Wemmerlov, 1990; Silvestro *et al.*, 1992). High customer contact refers to when a customer spends hours, days or even weeks in the service system per transaction, whereas low customer contact is when contact with the service system lasts only a few minutes (Silvestro *et al.*, 1992). These days, customer contact is generally defined and measured as a concept representing three dimensions of communication time, intimacy, and information richness in the interaction for a transaction (Kellogg and Chase, 1995).

In EC, face-to-face contacts, or off-line human interactions are minimized by technological applications. However, in many cases, it is just replaced by on-line interactions. Therefore, the dimensions of intimacy and information richness need to be emphasized to differentiate on-line interaction involved in human actions from automated on-line interactions. Also, in the case of automated on-line interaction, required time and complexity of on-line interaction need to be reflected to differentiate it from simple and easy on-line interactions. Therefore, in this study, the concept of on-line interaction includes the need of customer contact involved in human actions (such as e-mail, real time messaging, and multimedia conversations) concerning dimensions of intimacy

and information richness of interaction, as well as required time for a transaction and complexity of on-line interaction, whether it is automated or not.

The differences in the degree of these on-line interactions in EC are closely related to the characteristics of product/service processes as well as business strategies and technology applications. Transactions may require very high or low on-line interaction depending on characteristics of product/service processes, despite high on-line substitution. The following research proposition is developed to explore the effect of “the need for on-line interaction” on customer needs of geographical accessibility in EC. The need for on-line interaction could lead to the increase of customer needs of geographical accessibility in EC, due to the need for convenience in additional contact for after-sales services, complaints, and the need for reliability of services.

- P3.* The need for on-line interaction will contribute to the increase of customer needs of geographical accessibility in EC.

Need for on-line customization. Customization is also another factor that was used and recognized in many studies in traditional services (Lovelock, 1983; Schmenner, 1986; Silvestro *et al.*, 1992). A high degree of customization is where service processes can be adapted to suit the needs of individual customers. In contrast, a low degree of customization is characterized by a non-varying standardized process (Silvestro *et al.*, 1992).

In electronic commerce, standardization of on-line services is pursued through technological applications for efficiency in operations. However, in many cases, on-line customization by human support or automated customization is required to provide diverse services and increase the level of customer satisfaction. In particular, on-line customization by human support is inevitably required in many professional services. In this study, the concept of on-line customization includes the need for individually fitting services through configurations and negotiations involved in human actions (such as e-mail, real time messaging, etc.), as well as the need for automated customization. As a result, the need for on-line customization is greatly increased through EC, according to the characteristics of product/service processes. The need for on-line customization could lead to the increase of customer needs of geographical accessibility due to the need for additional contacts or reliability on services.

- P4.* The need for on-line customization will contribute to the increase of customer needs of geographical accessibility in EC.

Need for off-line interaction. Generally, off-line interactions are avoided to attain efficiency and effectiveness in EC operations. However, off-line interactions are still required in EC services in accordance to the characteristics of product/service processes. For example, tangible products need to be delivered off-line, and high interaction services can provide greater

convenience to customers in off-line services. As a result, on-line and off-line activities both need to be considered in EC. The following research proposition explores the effect of “the need for off-line interaction” to customer needs of geographical accessibility in EC.

P5. The need for off-line interaction will contribute to the increase of customer needs of geographical accessibility in EC.

Need for off-line customization. Off-line customization is frequently required for customer satisfaction in the transaction of tangible products or high interaction services. In addition, in many cases, off-line customization can be used for the differentiation of services and the acquirement of comparative competitiveness. Therefore, the need for off-line customization is found in many cases of EC, and which may positively effect customer needs of geographical accessibility.

P6. The need for off-line customization will contribute to the increase of customer needs of geographical accessibility in EC.

2.3 Reasons for customer needs of geographical accessibility

Regarding customer needs of geographical accessibility, two issues need to be considered. The first issue involves the need for geographical accessibility by the customer (as mentioned already in previous section) in the transaction of a specific product or service as an outcome from diverse reasons, and the second issue concerns the reasons generating customer needs of geographical accessibility. In this section, the reasons for customer needs of geographical accessibility are discussed for further study. For example, a customer may prefer to purchase a product from an approachable site in consideration of such factors that include the delivery cost and its impact on price, convenience in contact for after-sales services, claims, or possible visits to the service center. Moreover, trust in the retailer or delivery reliability of a product could also have an impact on determining customer needs of geographical accessibility for many customers. Many factors affecting customer needs of geographical accessibility are related to the characteristics of product/service processes, similar to the needs of customer support and logistics in EC (Hallowell, 2000) and the delivery of tangible services (Lovelock, 1983). However, beyond this, there may be products or services that do not require geographical accessibility.

3. Empirical analysis

In this section, a description of the data and methods used in the analysis are presented, and the resulting factors identified by statistical method are reported. Also, the results of the analysis on the relationships between characteristics of product/service processes and customer needs of geographical accessibility are explained according to the research

propositions. In addition, the reasons for customer needs of geographical accessibility are examined.

3.1 *Methods*

To collect data, a survey instrument was developed based on the six representative characteristics of product/service processes and customer needs of geographical accessibility in EC identified in the preceding section. Detailed variables explaining the representative characteristics were developed through discussion with several professionals, who are now employees in service or EC industries or doctorate students for service or EC management in graduate school, to reflect critical concepts in previous service literature in the traditional economy. For the characteristics that are unique to EC environment, which include on-line interaction and on-line customization, existing concepts from previous literature in the traditional economy were extended or modified to build detailed variables. Through these procedures, a questionnaire for preliminary testing was created. The final questionnaire was determined after correction of ambiguous sentences and excluding several poorly constructed variables. Preliminary testing was conducted twice. In the first test, the respondents' understanding to the description of detailed variables was tested on approximately 20 participants, and the second test examined construct validity of the questionnaire with 60 participants. Respondents were selected from the target population of this study.

To raise content validity, the survey was conducted based on the respondent's actual experience of purchasing a specific product or service in EC. Respondents were instructed to select a specific product or service to which they had experienced purchasing in EC, and to answer questions on the product or service. Respondents with no purchasing experience in EC were instructed to answer questions on a specific product or service to which they ought to have knowledge on its characteristics.

The questionnaires were composed of three categories of questions. The first category included questions measuring customer perception on the characteristics of product/service processes as independent variables. An additional single question on the needs of geographical accessibility by customers to a specific product or service selected by each respondent was included as a dependent variable. Independent variables included 19 questions developed to construct the six representative characteristics of product/service processes. The dependent variable was measured with a single item measure, since there were no validated multi-item scales available. The second category was composed of questions on the reasons for customer needs of geographical accessibility in the transaction of a specific product or service. The items were measured on a seven-point scale (1 = very low, 4 = middle, 7 = very high). In addition, the third category of questions concerned demographic factors and purchasing experiences in EC of respondents.

3.2 Surveys and data collection

The respondents were sampled from demographic groups who frequently use the Internet and have knowledge on the characteristics of transactions in EC. The purpose of limiting the target population of the survey is to raise the level of reliability for conceptual questions regarding the characteristics of product/service processes and customer needs of geographical accessibility. Respondent groups selected in this study were university students who attended relevant classes over a semester and white-collar employees in the service or EC industry. The survey was carried out during the period of June to August 2002. A total of 193 questionnaires were collected. For final analysis, 186 questionnaires were used, excluding seven questionnaires with numerous missing answers. Table I shows the demographic characteristics of the respondents.

3.3 Characteristics of product/service processes and geographical accessibility

Factor analysis. Factor analysis is useful in gaining an overall understanding of the main dimensions underlying the variables. In this study, exploratory factor analysis was conducted to reduce the number of variables and to extract the underlying dimensions, from each group of variables of product/service process characteristics and the reasons for customer needs of geographical accessibility. Principal component analysis (PCA) and the varimax rotation method were employed for factor extraction. Eigenvalue tests showed a five (characteristics of product/service processes) and three (reasons for customer

	Number of persons	(%)
<i>Gender</i>		
Male	156	83.9
Female	30	16.1
<i>Mean age</i>		
	33	
<i>Education</i>		
University student	113	60.8
University graduate (employees)	73	39.2
<i>Internet use</i>		
1-2 years	49	26.3
3-5 years	82	44.1
Over 5 years	55	29.6
<i>Purchasing experience in EC</i>		
Yes	161	86.6
No	25	13.4
<i>Purchasing intention in EC</i>		
Yes	173	93.0
No	13	7.0

Table I.
Demographics

needs of geographical accessibility) factor structure (eigenvalue = 2.37 ~ 4.63, 1.81 ~ 3.78) for each group of variables, and these factors explained 83.9 and 79.8 percent of the total variance. The relatively high factor loading scores verified the construct validity in the questionnaires. The results of χ^2 tests from confirmatory factor analysis (CFA) were also consistent with the five and three factor structure. In the group of independent variables, the χ^2 statistics from the result of CFA on 5-factor structure ($\chi^2 = 690.98$, $df = 148$) showed improved model fitness with significant difference compared to other cases (four-factors: 825.83, 149; three-factors: 1276.96, 150; two-factors: 1817.72, 151; single factor: 2052.32, 152). The case was the same for variables concerned with the reasons for customer needs of geographical accessibility. The three-factor structure showed improved model fitness compared to the other cases (three-factors: $\chi^2 = 229.53$, $df = 32$; two-factors: 322.67, 33; single factor: 578.78, 34). The differences of χ^2 statistics were also significant. In addition, the Cronbach's α resulted in values of 0.859~0.923, and 0.838 ~ 0.920 for each group of variables which are considered high and satisfactory as a measure of reliability. Generally, a Cronbach's α greater than 0.7 indicates internal consistency in the measured questionnaire.

As a result, 19 independent variables representing six characteristics of product/service processes were constructed into five factors from the exploratory factor analysis, integrating the characteristics of off-line interaction and off-line customization into a single factor, however, mainly supporting the factor structure developed from the literature review. The resulting factors are degree of product intangibility, proportion of on-line substitution for services, need for on-line interaction, need for on-line customization, and off-line interaction and customization, and the results of the analysis are shown in Table II. The dependent variable of customer needs of geographical accessibility to a specific product or service, measured as a single question's scale, was directly used for further analysis. In addition, ten variables reflecting the reasons for customer needs of geographical accessibility were formed into three factors: cost, speed, and quality; convenience in contact; and reliability. The results of the analysis are shown in Table III. From the results, the factor of cost, speed, and quality is related to the reasons for customer needs of geographical accessibility concerning transportation cost, on-time delivery, and quality maintenance in delivery services. And, the factor, convenience in contact, is concerned with the need for off-line complementary services, after-sale services and claims, personal visits and face-to-face contact. The factor of reliability is related to trust in the company or reliability of delivery services.

In further analysis, two relationships were examined. The first is the relationship between the factors of the characteristics of product/service processes and customer needs of geographical accessibility. The other is the relationship between independent variables and the reasons for customer needs

Factors and variables	Loadings	Reliability
<i>Factor 1 Degree of product intangibility</i>		
Costs of delivery are closely related to distance	- 0.889	0.923
Maintaining quality is critical in delivery process	- 0.919	
Transactions are involved in information, knowledge, or services	0.932	
Product and services are lowly involved in physical things	0.905	
Delivered objects can be digitalized	0.835	
<i>Factor 2 Proportion of on-line substitution for services</i>		
On-line transaction is technologically possible	0.867	0.892
Core services can be delivered on-line	0.865	
Off-line services are not needed	0.826	
<i>Factor 3 Need for on-line interaction</i>		
Required time of on-line contact per transaction	0.870	0.859
Need for on-line communication (e-mail, chatting, or multimedia)	0.831	
Complexity of on-line activity in transaction	0.810	
<i>Factor 4 Need for on-line customization</i>		
Individual requirements need to be handled on-line	0.891	0.904
Standardization of on-line services is difficult	0.892	
Diverse on-line service options are required	0.838	
<i>Factor 5 Off-line interaction and customization</i>		
Off-line contacts are highly required in transaction	0.690	0.922
Core services are delivered off-line	0.687	
Off-line customized services are required	0.882	
Off-line service qualities are critical	0.878	
Diverse off-line services are required	0.891	
Note: Eigenvalue: component 1 = 4.627, 2 = 3.647, 3 = 2.741, 4 = 2.561, 5 = 2.372		

Table II.
Factor analysis:
characteristics of
product/service process

of geographical accessibility. The first relationship was analyzed by multiple regression analysis, and the second was analyzed through Pearson's correlation and canonical correlation analysis.

Multiple regression analysis and testing propositions. To verify that product/service process factors are significantly related to customer needs of geographical accessibility, multiple regression analysis was conducted between the factors of product/service processes and customer needs of geographical accessibility. Based on the results, the research propositions in this study were examined.

The results of the analysis in Table IV show that each independent variable is significantly related to customer needs of geographical accessibility ($p < 0.05$). The increase of the degree of product intangibility ($P1$) and the proportion of on-line substitution for services ($P2$) contribute to the decrease of customer needs of geographical accessibility in EC (coefficient = -0.833, -0.345; $p = 0.000, 0.004$). In contrast, the need for on-line interaction ($P3$) and on-line customization ($P4$) contributes to the increase of customer needs of geographical accessibility in EC (coefficient = 0.283, 0.264; $p = 0.018, 0.027$). The need for

Factors and variables	Loadings	Reliability	Geographical accessibility in EC	
<i>Factor 1 Cost, speed and quality</i>				
Delivery cost effects on price	0.818	0.920	531	
Product and service can be delivered on-time	0.919			
Faster delivery is possible	0.920			
Maintaining quality is easier in delivery	0.810			
The risk of damages of product is reduced	0.817			
<i>Factor 2 Convenience in contact</i>				
Off-line complementary services are possible	0.857	0.869	Table III. Factor analysis: reasons for customer needs of geographical accessibility	
Convenience in after-sales services, claims and complaints	0.875			
Necessity of visits to off-line site	0.885			
<i>Factor 3 Reliability</i>				
It enhances the trust in selling companies	0.888	0.838		
It enhances the trust in reliable delivery of products or services	0.886			
Note: Eigenvalue: component 1 = 3.779, 2 = 2.390, 3 = 1.813				

Model	<i>B</i>	Beta	<i>t</i>	<i>p</i> -value	Table IV. Multiple regression analysis
Constant	4.140		35.002	0.000	
Degree of product intangibility	-0.833	-0.422	-7.026	0.000	
Proportion of on-line substitution for services	-0.345	-0.175	-2.909	0.004	
Need for on-line interaction	0.283	0.143	2.383	0.018	
Need for on-line customization	0.264	0.134	2.229	0.027	
Off-line interaction and customization	0.632	0.320	5.329	0.000	
Notes: Dependent variable: customer's overall perception to the needs of geographical accessibility; <i>R</i> square = 0.350; Regression model test (ANOVA): <i>F</i> = 19.374, <i>p</i> -value = 0.000					

off-line interaction (*P5*) and off-line customization (*P6*) were integrated to “the need for off-line interaction and customization” (*P5*, *P6*) to reflect the result of factor analysis, and this also contributes to the increase of customer needs of geographical accessibility in EC (coefficient = 0.632; *p* = 0.000).

Correlation analysis: further exploratory study. Correlation analysis was conducted to investigate the relationships between the factors of product/service processes and those of the reasons for customer needs of geographical accessibility. Through Pearson's correlation, as summarized in Table V, several significant correlations are found between factors of product/service processes and the reasons for customer needs of geographical accessibility. The factor of cost, speed, and quality is significantly correlated with factors of degree of product intangibility, proportion of on-line substitution for services, off-line interaction and customization (*p* < 0.01, 0.01, 0.01), and the factor of convenience in contact with need for on-line

interaction, need for on-line customization, off-line interaction and customization ($p < 0.01, 0.05, 0.01$), and finally the factor of reliability with off-line interaction and customization ($p < 0.05$). These results mean that customers require geographical accessibility due to the reasons of cost, speed, and quality concerning the characteristics of degree of product intangibility, proportion of on-line substitution for services, and need it due to convenience in contact concerning the characteristics of need for on-line interaction, need for on-line customization. And, in particular, the characteristics of off-line interaction and customization are related to all three reasons including reliability. The results explain that the characteristics of the product/service processes have meaningful relationships with the reasons for customer needs of geographical accessibility.

However, correlation analysis has limitations in explaining the overall correlation between groups of variables since it focuses only on individual correlations. For this reason, canonical correlation analysis was also conducted. Canonical correlation analysis contributes to the understanding of the characteristics of overall relationships since the correlation is analyzed according to critical dimensions. From the results of the squared canonical correlation, the first dimension was 0.629, 0.050 in the second, and 0.026 in the third, explaining 68 percent of the total correlations with the upper two dimensions, which is considered to be sufficient for the explanation of canonical correlations. Eigenvalues were 1.695 ($p < 0.0001$) for the first dimension and 0.053 ($p = 0.0800$) for the second. Multivariate statistics and F approximations also supported significant canonical correlations between two groups of variables, with the results of Wilks' Lamda (0.343, $F = 15.51$, $p < 0.0001$). Also, the results of Pillai's Trace and Hottelling-Lawley Trace statistics were turned out to be significant as well.

From the results of canonical correlation analysis, standardized canonical coefficients are summarized in Table VI according to critical dimensions. The first dimension, which explains most of the canonical correlation (62.9 percent), is concerned with the off-line service activity, whereas the second dimension explaining a marginal part (5 percent) is concerned with on-line service activities. Each dimension was labeled as off-line service activity for the first

	Cost, speed, quality	Convenience in contact	Reliability
Degree of product intangibility	-0.336**	-0.16	0.059
Proportion of on-line substitution for services	-0.467**	-0.78	-0.027
Need for on-line interaction	0.041	0.223**	0.045
Need for on-line customization	0.113	0.147*	0.136
Off-line interaction and customization	0.475**	0.198**	0.166*

Notes: * Significant on the level of 0.05; ** significant on the level of 0.01

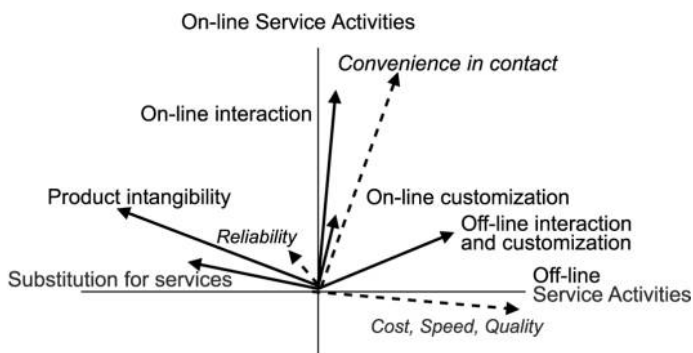
Table V.
Pearson's correlation
analysis

Table VI.
Standardized canonical
coefficient

	Off-line service activity (first dimension)	On-line service activity (second dimension)
Degree of product intangibility	-0.867	0.213
Proportion of on-line substitution for services	-0.270	0.036
Need for on-line interaction	0.079	0.900
Need for on-line customization	0.063	0.268
Off-line interaction and customization	0.407	0.264
Cost, speed, quality	0.987	-0.130
Convenience in contact	0.133	0.990
Reliability	-0.087	0.046

dimension, and on-line service activity for the second. As shown in the table, factors that are closely related to the off-line service activity, which include degree of product intangibility, proportion of on-line substitution for services, off-line interaction and customization, are highly loaded on the first dimension. In contrast, factors of need for on-line interaction and need for on-line customization that are related to the on-line service activity, are highly loaded on the second dimension. Furthermore, the factors of the first dimension are highly correlated with cost, speed, and quality, and the second dimension is highly correlated with convenience in contact.

These standardized correlation coefficients can be depicted on two axes as shown in Figure 2. In this figure, the horizontal axis represents the first dimension of off-line service activities from the canonical correlation analysis, and the vertical axis represents the second dimension of on-line service activities. In addition, the direction of the line of each factor represents the direction of correlation, and the length of the line represents the strength of correlation. From the figure, there are a very strong negative correlation between degree of product intangibility and cost, speed, and quality, and a positive correlation between need for on-line interaction and convenience in contact. In addition, there are very weak correlations between product/service processes and reliability.

**Figure 2.**
Description of
standardized correlation
coefficient

4. Summary and discussion

Through this study, we verified that the factors of product/service processes are significantly related to customer needs of geographical accessibility. In addition, we found that the relationships between characteristics of product/service processes and reasons for customer needs of geographical accessibility in EC are considered with two dimensions of off-line service activities and on-line service activities. In particular, off-line service activities have a domineering role in the canonical correlation with the reasons for customer needs of geographical accessibility. Therefore, from the results of multiple regression analysis and correlation analysis in this study, we can conclude that the six representative characteristics of product/service processes have a significant effect on customer needs of geographical accessibility. In addition, the results indicate that the reasons for customer needs of geographical accessibility are mainly related to the off-line service activities. In particular, from the results of the multiple regression analysis, the characteristics of service processes such as on-line interaction and customization, which are intangible, also have an effect on customer needs of geographical accessibility, although they turned out to have a marginal role in the canonical correlation with the reasons for customer needs for geographical accessibility. A customer may need geographical accessibility for convenience in off-line service activities such as face-to-face contact that could be additionally required in the transaction of services requiring high on-line interaction and customization, although it can be fully substituted to on-line. Therefore, operation strategies need to begin with the understanding on the characteristics of product/service processes, although it is generally mentioned that on-line channels can dramatically expand the market scope for intangible products. In particular, both characteristics of on-line and off-line service processes need to be considered in EC transactions in order to better understand customer needs of geographical accessibility.

Compared to previous studies, the results of this study are partly consistent with those of Phau and Poon (2000). They suggested that products and services that have the characteristics of low outlay and high frequency of purchase, intangible value proposition, and relatively high differentiation potential would be more suitable for selling through the Internet, based on the classification of goods and services. From these results, the characteristics of low outlay and frequent purchase, and intangible value proposition are related to the low interaction and high degree of intangibility in our study that similarly contribute to the decrease of customer needs of geographical accessibility. The decrease of customer needs of geographical accessibility may contribute to the increase of purchasing preferences in EC. The third characteristic cannot be simply compared with the results of our study because it is used in different contexts.

Implications on EC management

EC firms need to understand customer needs of geographical accessibility for building operational strategies concerning facility location, distribution network design, and scope of the target market. In addition, considerations of customer needs of geographical accessibility are important to EC firms, when we see that many companies have newly added off-line distribution outlets for customer needs, although these companies had started as pure on-line companies. Many of them inevitably experienced difficulties in expanding market scope and had problems in retaining customers in a wide geographical area before taking a further step in adding regional distribution centers off-line to meet customer needs of geographical accessibility. Although most customer needs can be handled on-line, many of the on-line companies, particularly tourism and airline-ticketing companies in South Korea, plan to build off-line distribution centers in each service region to better meet customer needs.

Customer needs of geographical accessibility in EC are influenced by the characteristics of the product/service processes, as verified in our study. Although it may be influenced by other factors such as company reputation, strategy, and prices, the characteristics of product/service processes need to be emphasized because they can be easily adaptable to any products or services to understand customer needs of geographical accessibility. In addition, customer needs of geographical accessibility need to be considered in the transaction of intangible services as well as that of tangible products. In general, tangibility of a product has been known to affect customer needs of geographical accessibility due to transportation costs, speed of delivery, and maintaining quality in delivery. However, the need of geographical accessibility is influenced also by the characteristics of intangible services such as interaction or customization. And, the reasons for customer needs of geographical accessibility are related to the characteristics of on-line service activities as well as off-line service activities in EC, even if the impact is not so big. A customer can perceive the need for geographical accessibility in a transaction requiring very high on-line interaction, even if this service can be fully substituted on-line. Examples of such services could be frequently found in the category of professional services such as management consulting.

EC changed the customer needs of geographical accessibility compared to that of the traditional economy. In transactions of some items, the market was dramatically expanded by EC, overcoming barriers of geographic distance. As a result, managers need to investigate the impact of EC on customer needs of geographical accessibility, and in turn, these characteristics need to be considered in developing operations strategies. Customer needs of geographical accessibility to a specific product or service are directly related to customer purchasing behavior.

Infrastructures, customer adoption, and geographical accessibility

The business environment in EC experiences more rapid changes than the traditional economy. In particular, these changes are closely related to EC infrastructures, Web technologies, and customer adoption. The impact of geographical accessibility in terms of customer perspectives need to be understood, not as fixed but rather as flexible, in the long-term view, dependent on the improvement of infrastructures, the development of technologies such as multimedia and intelligent agent, and the improvement of customer adoption to EC. Therefore, the direction and speed of changes in customer needs of geographical accessibility need to be investigated in anticipation of the future impact of EC on the service industry. The threshold area where consumers purchase a specific product or service without anxiety in EC could be expanded along with the improvement of the EC environment.

5. Conclusion

Although, it is generally mentioned that EC can overcome barriers of distance and lead to the dramatic expansion of markets relative to the traditional brick and mortar companies, customer need of geographical accessibility varies according to the characteristics of product/service processes. As such, customer needs of geographical accessibility are a critical factor in building EC operations strategies. We developed factors concerning the characteristics of product/service processes from previous literature review and verified that the factors have a significant effect on customer needs of geographical accessibility. In addition, we investigated the relationships between the characteristics and the reasons of customer needs of geographical accessibility. The results of our study will contribute to greater understanding of EC operations for academics and practitioners alike.

However, there are also challenges for future research due to the limitations in our study. First, this study did not provide the taxonomy of product/service processes concerning customer needs of geographical accessibility, focusing on the relationships between factors. However, empirical taxonomy on product/service processes can give greater understanding and discriminating insights to academics and executives on the characteristics of transaction concerning customer needs of geographical accessibility. Therefore, the research on the taxonomy of diverse transactions, which reflect the characteristics of customer needs of geographical accessibility in EC, will be required in the future. Second, this study focused on customer perceptions based on the survey on customer groups. However, although we tried to measure a customer's real purchasing behavior in the survey, by instructing respondents to answer based on real purchasing experiences to a specific product or service, the customer needs of geographical accessibility investigated in this study need to be confirmed with the relationship with customer purchasing behaviors, or with the geographical distribution of

customers in a specific EC firm. Third, customer needs of geographical accessibility are related to EC operations strategies such as facility location, distribution network design, and scope of target market. Therefore, the effect on EC operations needs to be investigated through an empirical study. Fourth, as mentioned above, EC environment changes with the improvements of infrastructure, technologies, and customer adoption, and customer perception to geographical accessibility vary with the changes of EC environment. Therefore, longitudinal studies will be required for greater understanding of the overall impact of EC on the service industry. Fifth, additional critical factors frequently adopted in previous studies on EC were company reputation, prices and frequency of purchase. These factors may still be critical in assessing customer needs of geographical accessibility. However, this study excluded these factors to exclusively focus on the characteristics of the product/service processes. Therefore, further research on the impact of these additional factors will also be required.

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