A STUDY ON USER ACCEPTANCE OF PORT COMMUNITY SYSTEMS

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Abstract

Port community systems (PCS) are computer networks which link up the port with all the companies that use it, including haulers, rail companies, shipping lines, feeder ports, shippers and customs officers. Although these systems have promising benefits for the users, a lot of companies are reluctant to adopt them. Thus this paper tries to derive the factors that affect PCS adoption. For this purpose a research model was constructed using Technology Acceptance Model (TAM). In order to confirm the model a questionnaire survey was conducted targeting the sea and land carriers located in the Busan Port area. According to the results, a direction of improvement was suggested for better PCS adoption.

Keywords: port community systems (PCS), electronic data interchange (EDI), technology adoption, Busan Port

1. Introduction

In the world of globalization, due to various changes in the international port logistics environment, such as increasing amount of international trade and container throughput, advent of ultra-large container vessels, changing customer demands, developments in information technology and new handling equipments, concerns about security and environmental issues, the advanced ports around the world are in a severe competition to ensure their container throughput and strategic position as "hub" ports. In order to confront this competitive pressure, ports are investing in infrastructure and improving their operation systems. These investments can be categorized in four general groups. First, ports have to provide deep berths to enable the safe docking of ultra-large container vessels. It would require construction of new berths or deepening the existing ones. The second one is related to new handling technologies and terminal automation for rapid handling of containers, such as advanced container cranes with tandem spreaders that can handle four 20-foot-containers and two 40-foot-containers at one time, driverless automated container carriers, and automated yard cranes that are remotely controlled. Terminal automation not only increases the container handling efficiency but also enables huge savings in operational costs. Thirdly, along with the terminal automation, the terminal operating systems (TOS) are also improved. Terminal operating systems are "computer systems available for organizing the container terminal itself" (Jeffrey, 1999). A typical TOS manages the flow of containers through the terminal, plans loading/unloading schedules and yard transfer operations, processes the containers transported into the terminal by rail or road, and notifies shipping companies and trucking companies about the locations of containers (Choi et al., 2003). Modern TOS applications use artificial intelligence to determine the optimum position of the container according to their shipping schedule and coordinate the operations within the terminal in order to increase the overall efficiency of the operations. Finally port community systems, which are "computer networks which link up the port with all the companies that use it, including hauliers, rail companies, shipping lines, feeder ports, shippers and customs officers"(Forward, 2003) are being implemented in order to reduce paperwork and facilitate the information flow related for port operations and customs declarations.

All these factors are necessary for the ports to keep competitive advantage. On the other hand research related to port community system development and adoption is relatively insufficient when compared to terminal operating systems and handling equipments. However port community systems require the participation of various organizations with different characteristics, often challenge them to integrate their systems or change their business processes. Previous studies state severe resistance of the port users which causes failure of the projects (Keceli, Choi & Park, 2007) or delays and additional costs (Jeffrey, 1999). Therefore, it can be concluded that there is necessity for determining factors affecting technology acceptance of port community systems. Thus, the purpose of this study is to derive the factors affecting the adoption of port community systems by the port users. .

2. Theoretical Background

2.1 Electronic Data Interchange (EDI)

Port community systems are generally based on Electronic Data Interchange (EDI) technology. According to UN/EDIFACT, EDI is "electronic transfer from computer to computer of commercial or administrative transactions using an agreed standard to structure the transaction or message data" (van Heck & Ribbers, 1999). Nowadays, the information within an organization is mainly processed by computers, but the data transfers between organizations are mainly based on papers, forms or printouts. EDI technology enables data transfer between organizations' databases without printing. The data is converted through data converter, transferred via e-mail, internet or a

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dedicated line, and decoded on the receiver side. The key to EDI is using the same data format on both sides of the transfer (Vincent, 2003).

Using EDI can lead important benefits to an organization, such as faster exchange of data without errors, reducing the communication costs, streamlining logistic processes, resulting in reduction of lead times, on time delivery and inventory reductions, improving the competitive position, e.g. by creating new kinds of services (van Heck & Ribbers, 1999). The study of Jimenez-Martinez and Polo-Redondo (2004) categorizes the benefits of EDI into three groups, i.e. direct benefits, such as paper savings, avoiding repetitive administrative procedures or reduction in administrative personnel, indirect benefits, such as avoiding errors, faster payments/improved cashflow, and finally strategic benefits, such as increasing business relationships with companies using EDI or improving customer loyalty.

Although the promising benefits of EDI, a lot of companies are reluctant to implement EDI (van Heck & Ribbers, 1999). The study of Suzuki and Williams (1998) addresses this resistance behavior and states that the resistance is due to uncertainty, lack of standards, and low perceived benefits.

Thus, there are plenty of previous studies about EDI adoption in various contexts and industries. These papers will be referred in detail for research model formulation in the following chapters. But most of these studies focus on information exchange between buyers and suppliers; however none of them targets adoption of port logistics related EDI or port community systems.

2.2 Port Community Systems

Traditionally, port users deliver cargo related documents and forms for port service requests through paper-based methods, such as sending a fax or handing in the documents directly. Sending the documents via e-mail also became a common practice due to the diffusion of the internet. The delivered information must be typed again into the port's information systems. Such typing works consume time and are vulnerable to typing errors. Port community systems allow the users to make service requests and input their information directly into the port's information systems. Such a system drastically decreases paperwork, improves data quality, enables data integrity among different stakeholders, and supports the port management for operations (Vincent, 2003; Zygus, 2006).

Rodon and Ramis-Pujol (2006) define port community systems as "an electronic platform that connects the multiple systems operated by a variety of organizations that make up a seaport community," and tries to explain the integration of an organization to an existing port community system. Rodon et al. (2007) analyzes the PCS in port of Valencia and tries to indicate the importance of standardization in B2B context. Mila (2007) give an overview about PCS and presents the results of a survey about the characteristics of PCS in 27 ports. Diop (2007) describes the basic characteristics of a PCS, indicates suitable architecture and explains the designs of PCS in Port of Dakar. Smit (2004) compares PCS of three ports in Europe; port of Antwerp, Hamburg and Rotterdam, on the basis of their architectures.

There are a few studies on port community systems; most of them are descriptive in nature (Rodon, J., Ramis-Pujol, 2006), i.e. the case studies on Portnet in Singapore (Applegate et al., 2001) or TradeLink in Hong Kong (King & Konsynski, 1990). They do not tackle the problem of the factors that affect the users' adoption of PCS. On the other hand the study of Keceli et al. (2007) states that the user resistance to adopt information systems offered by Kumport (a private port in Turkey) resulted in the failure of the system, whereas Forward (2003) states that getting the members of the port community in Cyprus actively involved in the system was more difficult than expected, which caused delays in the completion of the system. Thus, Cyprus Ports Authority directed its efforts at training and education. Thus more study on user acceptance of PCS is necessary. The results of the study can be directly utilized in future PCS implementation projects, and the success of the systems can be guaranteed with proper understanding of the factors affecting the adoption of such systems.

2.3 Port Community Systems in the World's Advanced Ports

Port community systems have various forms and characteristics in each and every port. Among them, Portnet in Port of Singapore is the one that is most studied in previous research. Port of Singapore Authority's (PSA) Portnet is the representative port community system since it is totally connected to PSA's terminal operating system (CITOS) and custom declaration system (TradeXchange) of Singapore government. Besides Portnet, Data Communications System (Dakosy) and COAST (Container Authorization System) of Port of Hamburg, Customer Plus Programme and OnePort Ltd. and Tradelink of Port of Hong Kong, PortofRotterdam.com, Virtual Port and WebJonas of Port of Rotterdam, PORT-MIS and KTNET in Busan Port can be considered as some of the well-known port community systems around the world. When the functionalities and services of these systems are examined, it can be easily concluded that not all of these systems offer full services required by the port community, but some of them only offer a portion of the services, depending on the major stakeholders of each system. These functions can be classified under three major categories, namely port management related tasks, customs related tasks, and online platforms for electronic commerce among the port users.

3. Research Methodology

3.1 Research Method

In order to derive the factors affecting PCS adoption, this research uses a questionnaire survey targeting the corresponding representatives of shipping companies and land transport companies in the Busan Port region. The collected data will be analyzed with SPSS and AMOS software packages using structural equations method.

3.2 Research Model and Hypotheses

On the basis of the previous studies on adoption of information systems similar to PCS, such as Electronic Data Interchange (EDI) and other inter-organizational information systems (IOIS), a research model was derived as shown in Figure 1.

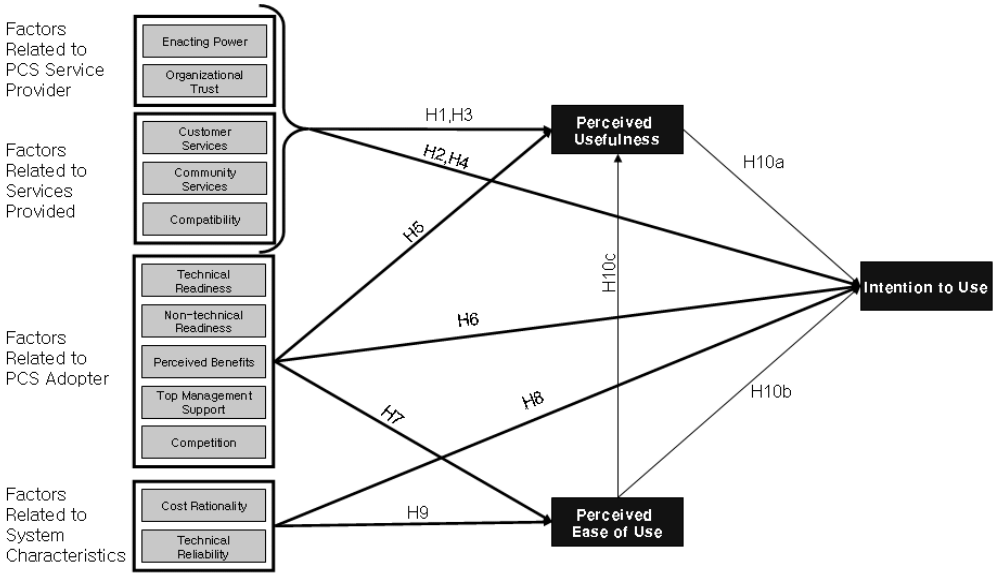

Figure 1 Research Model

According to the research model, independent factors affecting intention to use PCS are divided into four categories, namely factors related to PCS service provider, factors related to services provided, factors related to PCS Adopter and factors related to system characteristics. Factors related to PCS service provider refer to the power of the provider to influence the decision of the adopter, and the trust of the adopter towards the provider.

Factors related to services provided refer to customer services, community services and compatibility. Customer services are additional services offered by PCS to a single customer, which could not be achieved through other modes of communication, whereas community services are defined as additional services offered by PCS facilitating commerce between various customers, which could not be achieved through other modes of communication. Compatibility refers to the extent to which an innovation is perceived as consistent with existing procedures, value systems and needs of potential adopters. (Crum et al., 1996).

Factors related to PCS adopter refer to technical and non-technical readiness of the adopter, perceived benefits from PCS, top management support and competitive pressure on the adopter. According to Chwelos et al. (2001) the readiness of a company to adopt the new system is defined by measures whether a firm has sufficient IT sophistication and financial resources to undertake the adoption of EDI. IT sophistication captures not only the level of technological expertise within the organization, but also assesses the level of management understanding of and support for using IT to achieve organizational objectives. To be more specific, technical aspects of readiness such as hardware and software capabilities are considered separately from non-technical aspects such as know-how, expertise and financial readiness. Competition is considered as the ability to maintain or increase competitiveness within the industry (Chwelos et al., 2001), whereas top management support refers to the innovativeness and involvement of CEO (Al-Qirim, 2007).

Finally, factors related to system characteristics refer to the rationality of the cost of using the system over its benefits and the technical reliability of the system, i.e. the ability of the system to perform a required function under stated conditions for a stated period of time (Walls et al., 2006). These factors are the main differences between conventional EDI based on value added networks (VAN) and XML/EDI systems based on the web (Hsieh and Lin, 2004; Ratnasingham, 1998).

In accordance with the research model, the research hypotheses are derived as shown in Table 1.

4. Research Results

Before the actual survey, a pilot test was conducted on ten responsible employees of a shipping company in Busan. After verifying that the contents of the questionnaire are consistent and easily understood by the respondents, actual questionnaire survey was conducted in April 2008. The self-administered questionnaire was consisted of 7-point Lickert scale questions, and the survey was conducted by direct visits to the sea and land carrier companies in Busan Port region. The demography of the respondents are given in Table 2.

Table 2. Demography of the respondents

Characteristics		Sea Transport Companies	Land Transport Companies
Number of respondents		107 out of 139	86 out of 114
Response rate		77%	76%
Distribution of ranks	Clerk	43.88%	37.5%
	Deputy chief	19.39%	25%
	Chief	24.49%	17.5%
	Manager	7.14%	7.5%
	Executive officer	5.10%	7.5%
	President	0%	5%
Average years of work experience		7.2 years	6.6 years

Table 1. Research Hypotheses

No.	Hypothesis	Source
H1a	Enacting power has significant positive impact on perceived usefulness	Grandona,E. E. ,Pearson, J. M. (2004); Lua,J., Yaob, J. E., Yu, C.S.(2003); Hu, P.J.H., Clark, T.H.K., Ma, W. W. (2003); Liao, C., Chen, J.L., Yen, D. C. (2007), van Raaij, E. M., Schepers, J.J.L. (2008)Lee, K.C., Kang, I.W., Kim, J.S. (2007)
H1b	Organizational trust has significant positive impact on perceived usefulness	Pavlou (2003)
H2a	Enacting power has significant positive impact on intention to use	Ngai, Gunasekaran, (2004); Seyal et al. (2007); van Heck & Ribbers, (1999), Hart & Saunders, (1998); Akos, N. (2004);
H2b	Organizational trust has significant positive impact on intention to use	Crum et al. (1996), Holmes, Srivastava, (1999), Carter and Bélanger, (2005); Hart & Saunders, (1998);
H3a	Customer services has significant positive impact on perceived usefulness	Lee et al (2003);
H3b	Community services has significant positive impact on perceived usefulness	Lee et al (2003);
H3c	Compatibility has significant positive impact on perceived usefulness	Venkatesh, Davis (2000); Sun, Zhang, (2004); Achjari and Quaddus (2002); Quaddusa & Xu (2005); Tung, F.C., Chang, S.C. (2008), Fu, J.R.,Farn, C.K., Chao, W.P. (2006), Wua, J.H., Wang, S.C. (2005)
H4a	Customer services has significant positive impact on intention to use	Seyal et al. (2007); Lee et al (2003);
H4b	Community services has significant positive impact on intention to use	Seyal et al. (2007); Lee et al (2003);
H4c	Compatibility has significant positive impact on intention to use	Lee (1998), Crum et al. (1996), Al-Qirim (2007), Zhu et al. (2002); Carter and Bélanger (2005); Premkumar & Roberts (1999); Ramamurthy & Premkumar (1995);
H5a	Technical readiness has significant positive impact on perceived usefulness	Lin et al. (2005);
H5b	Non-technical readiness has significant positive impact on perceived usefulness	Lin et al. (2005);
H5c	Perceived benefits has significant positive impact on perceived usefulness	Amoako-Gyampah, K., Salam, A.F. (2004); Ramayah, T., Lo, M.C. (2007)
H5d	Top management support has significant positive impact on perceived usefulness	Sun, Zhang (2004); Liao and Raymond (2000); Quaddusa & Xu (2005);
H5e	Competition has significant positive impact on perceived usefulness	Quaddusa & Xu (2005);
H6a	Technical readiness has significant positive impact on intention to use	Lee (1998); Chwelos et al. (2001); Ngai, Gunasekaran (2004), van Heck & Ribbers (1999), Wang et al. (2004), Zhu et al. (2002); Ramamurthy & Premkumar (1995);
H6b	Non-technical readiness has significant positive impact on intention to use	Chwelos et al. (2001); Ngai, Gunasekaran (2004), van Heck & Ribbers (1999), Crum et al. (1996), Holmes, Srivastava (1999), Zhu et al. (2002); Fernandes et al (2006); Premkumar & Roberts (1999); Ramamurthy & Premkumar (1995);
H6c	Perceived benefits has significant positive impact on intention to use	Lee (1998); Chwelos et al. (2001); Ngai, Gunasekaran (2004), Seyal et al. (2007), Suzuki, Williams (1998), van Heck & Ribbers (1999), Crum et al. (1996), Wang et al. (2004), Al-Qirim (2007), Carter and Bélanger (2005); Murphy & Daley (1998); Akos, N. (2004); Fernandes et al (2006); Premkumar & Roberts (1999); Ramamurthy & Premkumar (1995);
H6d	Top management support has significant positive impact on intention to use	Lee (1998), Ngai, Gunasekaran (2004), Seyal et al. (2007), Crum et al. (1996), Wang et al. (2004), Al-Qirim (2007), Fernandes et al (2006); Premkumar & Roberts (1999); Ramamurthy & Premkumar (1995);
H6e	Competition has significant positive impact on intention to use	Lee (1998), Ngai, Gunasekaran (2004); Crum et al. (1996), Al-Qirim (2007), Fernandes et al (2006); Premkumar & Roberts (1999);
H7a	Technical readiness has significant positive impact on perceived ease of use	Lin et al. (2005)
H7b	Non-technical readiness has significant positive impact on perceived ease of use	Lin et al. (2005)
H7c	Perceived benefits has significant positive impact on perceived ease of use	Amoako-Gyampah, K., Salam, A.F. (2004); Ramayah, T., Lo, M.C. (2007)
H7d	Top management support has significant positive impact on perceived ease of use	Sun, Zhang (2004);
H7e	Competition has significant positive impact on perceived ease of use	Henderson, R., Divett, M. J. (2003)
H8a	Cost rationality has significant positive impact on intention to use	Lee (1998), Crum et al. (1996), Al-Qirim (2007), Akos, N. (2004), Premkumar & Roberts (1999); Ramamurthy & Premkumar (1995); Lee et al (2003); Tung, F.C., Chang, S.C. (2008)
H8b	Reliability has significant positive impact on intention to use	Lee (1998), Ngai, Gunasekaran (2004), Suzuki, Williams (1998), van Heck & Ribbers (1999), Carter and Bélanger (2005);
H9a	Cost has significant positive impact on perceived ease of use	Hertzum, M. (2002)
H9b	Reliability has significant positive impact on perceived ease of use	Liao and Raymond (2000); Arning, K., Ziefle, M. (2007); Lu, C.S., Lai, K.H.,Cheng, T.C.E. (2007); Ahn, T., Ryu, S.W., Han, I.G. (2007)
H10a	Perceived usefulness has significant positive impact on intention to use	Davis et al. (1989), Venkatesh, Davis (2000); Seyal et al. (2007); Carter and Bélanger (2005); Liao and Raymond (2000); Lee et al (2003);
H10b	Perceived ease of use has significant positive impact on intention to use	Venkatesh, Davis (2000); Crum et al. (1996), Carter and Bélanger (2005); Liao and Raymond (2000); Premkumar & Roberts (1999); Ramamurthy & Premkumar (1995); Lee et al (2003);
H10c	Perceived ease of use has significant positive impact on perceived usefulness	Liao and Raymond (2000); Quaddusa & Xu (2005); Tung, F.C., Chang, S.C. (2008)

In order to verify whether the hypotheses are accepted, the questionnaire results were analyzed structural equation modeling. The model fit results are given in Table 3, all of which are in acceptable limits.

Table 3. Model Fit Values

Indicator	Value	Criterion of Acceptance
CMIN/Df	1.049	< 2
NFI	0.995	< 0.95
RMSE	0.016	< 0.05

The regression values and the acceptance of each hypothesis are given in Table 4. In this table, the accepted hypotheses that have a P value less than 0.001(i.e. accepted in almost 100% of the cases) are marked with three asterisks, the ones with a P value less than 0.01 (i.e. accepted in more than 99% of the cases) are marked with two asterisks and the ones with a P value less than 0.05 (i.e. accepted in more than 95% of the cases) are marked with one asterisk. The hypotheses with a P value more than 0.05 are rejected.

Table 4. Regression values

Hypothesis	H1a	H1b	H2a	H2b	H2c	H3a	H3b	H4a	H4a	H4b	H4c
Estimate	0.07	0.21	-0.1	-0	0.11	0.09	-0	0.12	0.12	-0.2	-0.1
P	0.11	0	0.26	0.88	0.04	0.11	0.98	0.15	0.15	0.03	0.4
Decision	R	**	R	R	*	R	R	R	R	*	R
Hypothesis	H5a	H5b	H5c	H5d	H5e	H6a	H6b	H6c	H6d	H6e	H7a
Estimate	-0.1	-0.1	0.29	0.13	0.28	0.09	0.14	0.02	0.38	-0.1	0.13
P	0.08	0.15	***	0.01	***	0.08	0.02	0.84	***	0.16	0
Decision	R	R	***	**	***	R	*	R	***	R	**
Hypothesis	H7b	H7c	H7d	H7e	H8a	H8b	H9a	H9b	H10a	H10b	H10c
Estimate	0.15	0.2	0.08	0.16	0.03	0.13	0.1	0.22	0.29	0.07	0.34
P	0.01	0.01	0.17	0.01	0.54	0.06	0.03	***	0	0.4	***
Decision	**	**	R	*	R	R	*	***	**	R	***

Finally according to the results, squared multiple correlations of the dependent variables indicate the percentage of dependent variables explained by the independent variables. In this cases 62.5% of perceived ease of use, 75.3% of perceived usefulness and 64.1% of intention to use is explained by the independent variables, thus one can conclude that the research model is powerful enough to explain the dependent variables by the given independent variables.

5. Discussion on the Results

On the basis of the results, top management support appears to be most important that has positive impact on PCS adoption, followed by non-technical readiness, competition, perceived benefits, organizational trust, compatibility, technical reliability, technical readiness and cost rationality, respectively. Enacting power and customer services have no influence on PCS adoption whereas community services have a negative impact. When previous research on technology acceptance was surveyed, it can be easily concluded that the results of the study is in compliance with previous research on technology acceptance of various other systems in individual and organizational level (Jeyaraj et al., 2006; Sabherwal et al., 2006).

According to the research outcomes, the impact of perceived usefulness is 0.28, which is higher than that of perceived ease of use (0.09). This means the probability that use of the system increasing the user's job productivity is considered to be more important than the system being easy to use itself.

Among each factor group, the one with maximum total impact on intention to adopt PCS was factors related to PCS adopter (0.774), followed by factors related to PCS service provider (0.051), factors related to system characteristics (0.029) and factors related to services provided (-0.113) respectively. These results imply that the successful acceptance of the system by the users mostly depend on the user, rather than the service provider or the system itself. Thus user involvement is considered to be essential for the success of the system.

Non-technical Readiness, being more important than Technical Readiness, implies that know-how transfer, human resources cultivation, training, etc. can significantly contribute to PCS adoption. Also financial support as incentive can also contribute to adoption.

The results point out that additional customer services have no significant impact on PCS adoption for users in Busan Port area. This implies that the main functionality of the system, such as submission of required documents, customs declarations and application for port services are adequate for the adoption of the system; even the system offers no additional services, such as transshipment management, container management, or other logistics and supply chain management solutions. But the results should not be interpreted as "additional services should not be offered"; since such services are means for creation of economic value added and revenue for the provider. But it appears to have no influence on the users for making the decision to adopt the system.

On the other hand, community services appear to have negative influence on the system adoption. This implies that an e-business platform that enables online business relations between port related companies actually decreases

the level of intention to adopt the system. On the basis of the interviews made with field experts, it was discovered that the companies in Busan Port area are reluctant to use a centralized portal site for e-business. There were several projects on this subject, but they all got cancelled due to low level of use. For example Empty Vehicle Management System, promoted by KL-Net was designed to display the cargo information on a public network and to assist the land transport companies with fleet management and operation planning. But the response of the companies was not friendly, since the system was considered as a threat to the competitiveness of their company by enabling every company to access every single cargo that appears in the system. On the other hand field experts from adopter companies claim that their in-house B2B systems are much cheaper and effective than those services offered by the service provider company.

Generally, trust towards service supplier becomes more and more important when reliability of the system decreases (Ratnasingham, 1998). In the case of Busan Port, reliability of the system is ranked more important than the trust towards the service provider.

From system development point of view, our results indicate that compatibility is more important than Technical reliability, which is also more important that cost rationality. It implies that PCS development projects should start with analyzing not only business processes, but also belief/value systems of the adopters. Then, a robust network to avoid congestion, and secure transactions should be ensured for reliability. Finally a Web-based XML/EDI system should be considered for lower transaction costs. At the beginning VAN-based EDI systems were preferred because of high reliability and speed. But as XML/EDI-based networks are rapidly gaining ground since the internet technology has matured and become available for a wider base. According to our results, reliability of the system appears to be more important than cost of the system. Thus issues like network capabilities, standardization and security must be emphasized in system development,

As the result of the factor analysis, among various benefits that PCS offer, the users are more interested in increased operational productivity, rather than cost reduction or enhanced relations with business partners.

Finally, enacting power having no impact on PCS adoption indicates that potential users in Korea would adopt the system if they perceive the benefits, even if it is not forced by the government.

6. Conclusions

In this study, the factors affecting PCS adoption by the sea and land carrier companies were examined. A questionnaire survey was conducted to test the impact of various factors on PCS adoption. According to the results; among four factor groups, factors related to PCS adopter appeared to have the most important influence on PCS adoption. Factors related to PCS adopter consist of top management support, adopters' technical and non-technical readiness, competition and perceived benefits. On the other hand, additional services, such as logistics solutions or e-Business functionality among the PCS users have the least impact on the system adoption.

Thus on the basis of the research results; following conclusions are drawn;

1. Since factors related to PCS adopters have the most significant impact on PCS adoption, future PCS development projects must be conducted by emphasizing close relations with potential user in order to ensure their understandings about the benefits of the system.
2. Government support to improve potential users' technical infrastructure and training programs to improve their technical know-how would increase the probability of successful technology acceptance.
3. As perceived benefits of the system, users are more interested in operational productivity, rather than cost reduction or improved business relations.
4. Reliability of the system is considered to be more important than cost, thus security, encryption and networking issues must be fully considered in PCS development.
5. Users consider e-Business on an open platform as a threat to their competitiveness. Thus more detailed analyses are needed to develop a business model to overcome this issue.

The research results are exposed to several limitations. First of all, it was very difficulty to access questionnaire respondents due to limited number of potential respondents. In order to ensure high response rates, the questionnaires were distributed directly to the respondents. Negative attitude of some respondents against questionnaire was observed. It is also difficult to generalize the outcomes for other ports around the world, since PCS adoption behavior differs significantly in different countries (Vincent, 2003). Thus contribution of this study is mainly focused on verifying the model for future PCS adoption studies. Due to limited time and physical resources, the survey was limited to the users in Busan. Therefore future research for other ports around the world is needed. Finally; again due to limited time and physical resources, the survey was limited to sea and land carriers. Thus future research on other stakeholders of a port community, such as service providers, bunkering, vessel crew management, brokers, ship inspections, immigration …etc. is definitely needed.

Port community systems are very rich in research topics. First of all, security and reliability issues must be solved for successful implementation of internet based PCS. When technical issues are solved, it would be possible to implement more reliable and cheaper systems. Another important research subject would be enhancing the study to an international level. Thus the differences in PCS adoption behavior according to national and port related factors could be seized. Finally, more detailed analyses are needed to fully understand the resistance behavior of the users against B2B services offered through PCS. Hence design of a B2B network that would create added value while maintaining users' competitiveness could be possible.

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