

Original article

## The Moderating Effect of Logistics Information Systems on Inter-organizational Collaboration and Performance of Korean Shipping and Logistics Firms

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### Abstract

The aim of this research is to verify the moderating effect of logistics information systems (LIS) on inter-organizational collaboration (IOC) and performance. To achieve this aim, this research pulled out the definitions of the variables from prior research and looked at the relationships between them. The population is the Korean shipping and logistics firms in the Republic of Korea, and a survey was carried out by members of liners and international freight forwarders. The questionnaires responded to by members of the sample firms were used as data for the analysis of this research. The reliability and validity of the data were tested by a factor analysis and the Cronbach's alpha coefficient. In addition, the hypotheses of this research have been verified using a multiple regression analysis. The results are as follows. LIS is confirmed as a factor in enhancing the relationship between IOC and performance. The firms perform IOC by LIS in supply chains and as a result, they can achieve high performance. This is explained by fit as moderation by Venkatraman (1989). In addition, the relationship between IOC and performance is explained by a resource-based view as is and the relationship between LIS and performance is also explained by a resource-based view. . Managers grasp customer needs and disseminate the needs to organizations using superior LIS, followed by high performance. Managers structure efficient supply chain processes through IOC between organizations and improve performance in the whole process through collaboration with the partners as well as departments. If managers want to achieve high performance through IOC, they should grasp their current level of LIS. This provides information; such as-, what strategic decision making could improve their performance? The results of this research prove the moderating effect of LIS on IOC and performance and if managers focus on the moderating effect, they can improve performance.

**Keywords:** IOC, Performance, LIS, Moderating effect

## **I. Introduction**

International logistics firms are subject to performing sea transportation and they play the role of a carrier in treating the goods of shippers. From this viewpoint, they perform sea transportation and the subsidiary logistics services are performed by their partners. The services are various, such as loading/unloading, bonded transportation, custody and customs clearance, and various firms participate in the logistics service process. International logistics services have the feature of not having face-to-face contact with shippers. Logistics service providers act as a proxy for the work on behalf of the shippers. The entities which perform these kinds of logistics services are loading firms, container terminals, bonded warehouse operators, bonded transporters, customs house brokers and so on. In this regard, international logistics firms play the role of a proxy to connect shippers with logistics services. In addition, liners mainly treat full container-loaded cargoes and international freight forwarders mainly handle less than container-loaded cargoes. All of them provide shippers with multimodal transportation, such as a door-to-door service. From this viewpoint, IOC of logistics firms is of importance with regards to the relationship with their logistics partners as well as for their relationship with the shippers. They are highly competitive in the market and, to overcome this, perform IOC. Therefore, it is important to study international logistics firms because research concerned with IOC and the performance of these firms is connected with enhancing the competitiveness of their international transportation service.

Prior research has been carried out from various viewpoints concerned with IOC. It has looked at it from the viewpoint of supply chains. In this regard, collaboration can be divided into vertical and horizontal in supply chains (Barratt, 2004). In addition, it can be classified according to width and depth (Matopoulos et al., 2007). This is concerned with the criteria of the classification. The viewpoint of Barratt (2004) is to approach IOC from a structural viewpoint and the viewpoint of Matopoulos et al. (2007) is to approach it from a behavioral one. Firms, through IOC, can save costs from the internal viewpoint and improve services from the external viewpoint (Lai et al., 2002). From the viewpoint of international logistics firms, internal organizational collaboration is the cause of cost saving through cooperation among departments. In addition, they grasp customer needs through cooperation with shippers as customers and achieve superior customer service through sharing their needs with logistics service providers. Therefore, IOC of international logistics firms has a positive effect on performance.

Despite prior research from various viewpoints on IOC and performance, research from the viewpoint of international logistics firms is still lacking. In addition, research into the factors which enhance the relationship between IOC and performance is required. This can verify factors ~~need~~ to enhance IOC and, as a result, the verification can be the basis of whether the factors enhance ~~its~~ performance through interaction with IOC. From this viewpoint, the aim of this research is to verify the moderating effect of LIS on the relationship between IOC and performance.

## **II. Literature review**

### *2.1. Literature review*

Research into IOC is performed from various viewpoints. Research into internal integration (Saeed et al., 2011; Simatupang & Sridharan, 2005) from the internal viewpoint of firms has been performed, as well as research on supplier integration (Tsai et al., 2012) and customer integration (Fynes et al., 2005; Kahn et al., 2006) from the external viewpoint of firms (Schoenherr & Swink, 2012; Singh & Power, 2009) in supply chains. There has also been research to consider all internal and external collaboration from the viewpoint of supply chains (Wong et al., 2011). The research has confirmed that IOC has a positive influence on performance (Rajaguru & Matande, 2009; Rosenzweig et al., 2003). In this regard, the relationship between IOC and performance can be explained by a strategic choice theory. Firms decide a strategy for improving performance. When managers choose a strategy, they need to reflect upon the character of the resources which the firms have, and need to consider recognition of environment. From this viewpoint, firms can improve performance by following through on their chosen strategy which takes into account the external environment and internal resources. Therefore, IOC is regarded as a strategic choice by firms and through this they can achieve a high level of performance.

Prior research has verified that information systems (Rodrigues et al., 2004; Iyer, 2011) have a positive effect on IOC and the interaction between internal and external integration (Flynn et al., 2010; Schoenherr & Swink, 2012) has a positive effect on performance. Research concerned with the above variables which enhance the relationship between collaboration and performance offers a viewpoint of fit as moderation by Venkatraman (1989). In addition, fit as mediation by Venkatraman (1989) reflects the viewpoint that collaboration mediates the relationship between antecedents and performance. From this viewpoint, this research will ascertain the factors which enhance the relationship between IOC and performance to reflect the notion of fit as moderation by Venkatraman (1989). This means that this research will identify the variables which have a positive effect on IOC and then one can ascertain whether the variables enhance the relationship between IOC and performance. In this regard, prior research is based on the following limitations.

First, research on the factors which enhance the relationship between IOC and performance is required. Prior research has suggested various influencing factors which have a positive effect on collaboration in supply chains. However, there is a lack of prior research concerned with a moderating variable to enhance the relationship between IOC and performance. Some researchers have ascertained that environmental uncertainty enhances the relationship between supply chain integration and performance (Wong et al., 2011). In addition, others have found that interaction between internal integration and external integration has a positive effect on performance (Flynn et al., 2010; Schoenherr & Swink, 2012). However, they did not consider internal factors due to excessive stress on external factors. Therefore, this research will investigate LIS as an internal factor to enhance the relationship between IOC and performance.

Second, research on IOC from the viewpoint of logistics service providers is required. Almost all of the prior research has investigated IOC from the viewpoint of manufacturing firms.

However, IOC can be classified into vertical and horizontal collaborations (Barratt, 2004). The viewpoint of manufacturing firms is regarded as the former and the viewpoint of international logistics firms is regarded as the latter. IOC from the viewpoint of international logistics firms is regarded as mediating the relationship between shippers as customers and port logistics firms as service providers. The viewpoint of IOC reflects the viewpoint of fit as moderation by Venkatraman (1989) and this research will ascertain this. Therefore, this research will perform a study of IOC from the viewpoint of international logistics firms.

### *2.2. The moderating effect of LIS on the relationship between IOC and performance*

IOC should include communication between departments, decision-making processes among supply chain partners and joint responsibility as a result. Managers make an effort to structure a collaborative mind between departments and firms for optimum performance. If managers recognize gaps in the goals of departments, firms and supply chains, they should make an effort to accord supply chain goals with departmental and corporate goals and, as a result, value is added to the supply chain process (Stank et al., 2001). In addition, firms should share information with suppliers for quick, correct responses to customer needs and, consequently, provide customers with quality services through collaborative efforts for joint goal achievement. For this reason, firms can provide customers with a far superior service when compared to competitors. In addition, IOC starts with the internal processes of firms and is disseminated to the inter-corporate viewpoint (Stevens, 1989). This means that firms can achieve efficiency in their internal processes through removing the overlaps and inefficiencies that exist in firms and improve their effectiveness in external processes through collaboration with supply chain partners. Through acquisition of market information, the improved IOC contributes to cost saving and service improvement (Bae, 2014, pp. 97-99). From this viewpoint, the moderating effect of LIS is connected with the work to create internal efficiency through inter-departmental collaboration, and the construction of supply chain efficiency through inter-corporate collaboration. Firms, through the moderating effect of LIS, can save costs through the efficient use of resources, achieve efficiency through the elimination of overlapping resources, perform a proper rearrangement of resources, and attain efficiency in processes.

IOC is important for external organizations as well as internal organizations. This means that firms require collaboration between marketing, logistics and production departments, between the supply plans of suppliers and production plans of manufacturers and also between the production plans of manufacturers and the distribution plans of wholesalers and retailers. IOC is important in logistics operations and it is connected with efficiency and effectiveness through dissemination to other functional areas. From the viewpoint of logistics, it is possible for the IOC to reduce stock levels, decrease frequency of delivery and the efficient management of stock, and facilitate an instant response that reacts to demand through collaboration with marketing and save on stock management costs through collaboration with production.

From this viewpoint, IOC can remove the overlaps and inefficiencies in whole processes and, as a result, firms can improve customer service through saving costs and grasping and achieving customer needs. In addition, international logistics firms which have a high level of IOC can achieve a higher level of performance when compared with their competitors (Daugherty et al., 1996). They should collaborate effectively with shippers as customers and efficiently manage other logistics firms as logistics service providers. For efficient external organizational collaboration, they need to understand each other, possess common rules, share resources, and achieve joint goals with partners. They can save on order costs, custody costs and stock management costs in their activities with shippers, and contact costs and operational costs in activities with their partners through IOC. The collaborative relationship between firms has a positive influence on cost saving (Larson, 1994). In addition, supply chain partners can grasp customer needs through collaboration with shippers and can achieve these needs through collaboration with other logistics firms.

Superior LIS plays an important role in achieving the strategic goals of IOC (Bae, 2014, p. 58). It has a goal to achieve high performance through external organizational as well as internal organizational collaboration. In this regard, the most important factor of IOC is to share information with both internal and external firms. LIS makes information sharing possible. Managers grasp market information and customer needs through LIS, share the information with other departments and structure logistics processes to reflect customer needs.. From this viewpoint, LIS supports the inter-departmental collaboration of international logistics firms and is used as a necessary factor in integrating external processes, including those of suppliers of logistics services and shippers (Power, 2005). LIS plays a role in promoting information sharing from the internal and external viewpoints of international logistics firms and, as a result, firms can save costs through removing inefficiencies and overlaps from an internal point of view and improve customer service through structuring collaborative service processes with suppliers from the externally.

The effort to achieve IOC is sometimes confronted with resistance and barriers in supply chains. Information distortion and asymmetry are examples of such barriers. If a firm has a monopoly on information, performance declines and the supply chain collapses. For this reason, international logistics firms prevent information distortion and asymmetry through systems designed to share internal information, such as EDI (electronic data interchange) and ERP (efficient resource planning), and external information, such as CRM (customer relationship management) and DRP (distribution resource planning). Information sharing using LIS supports IOC and, as a result, international logistics firms can achieve a superior performance through flexible information sharing among departments and partners. From this viewpoint, firms, through usage of LIS, can perform effective communication between departments and effective collaboration with shippers and partners in the whole supply chain. Therefore, LIS plays the role of a catalyst in enhancing the relationship between IOC and performance. Prior research has confirmed that LIS has a positive effect on both internal collaboration (Green et al., 2012; Williams et al., 1997) and external collaboration (Iyer, 2011; Paulraj & Chen, 2007). In addition,

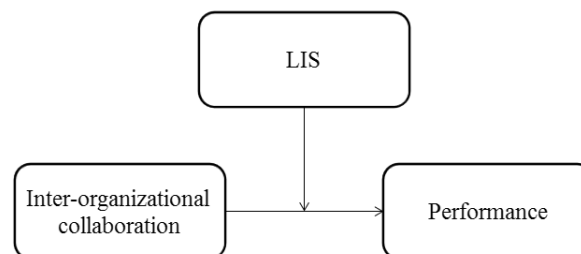
prior research has ascertained the moderating effect of LIS on the relationship between collaboration and performance (Gustin et al., 1995). The results of prior research have also explained that LIS enhances the relationship between IOC and performance. This can be explained by the concept of fit as moderation from Venkatraman (1989). Therefore, this research proposes the following hypotheses.

*H. 1 LIS enhances the relationship between inter-organizational collaboration and cost saving (H. 1-1) and service improvement (H. 1-2).*

### **III. Research Model and Methodology**

#### *3.1. The research model*

To verify the moderating effect of LIS on IOC and performance, this research proposes a research model as follows.



**Figure 1: The research model**

As shown in Figure 1, the research model explains the moderating effect of LIS on the relationship between IOC and performance.

#### *3.2. Conceptual definitions, data collection and analytical methods*

To achieve the aims of this research, conceptual definitions of variables are suggested by prior research. LIS means that the integrated concept of information systems can add value to the international logistics process (Bae, 2012; Closs et al., 1997). IOC is divided into internal organizational and external organizational collaboration; the former means cooperation and interaction which are come from the flow of information and the management of human and physical resources in international logistics firms (Bae, 2012; Stank et al., 2001) and the latter means an integrated approach to management for all supply chain partners (Bae, 2012). Performance is classified into cost saving and service improvements; the former means the degree of logistical cost savings generated in the whole processes (Closs et al., 1997; Lai et al., 2002) and the latter refers to the capability of whole logistics services provided by international logistics firms (Closs et al., 1997; Lai et al., 2002).

To achieve the aims of this research, the investigation is performed within international logistics firms. The sample frame is a membership list of the Korean International Freight Forwarder Association, a membership list of the International Shipping Agency Association for

Korea and a membership list of the Korea Shipowners' Association. This research conducted a survey with all of the firms in the sample frame. The survey was conducted by mail, email, telephone, fax and personal visits to the firms which consented to taking part in the survey. A questionnaire was sent to staff in the sales department or sales management departments of the firms. The survey was carried out during the period between September to December 2014 and 165 items of data were collected; 163 pieces of data were used in the analysis because two surveys contained serious problems in their responses and, as a result, were excluded. This research ascertained non-response bias. The data was divided into four clusters in the order that they arrived and the gap in the responses between the first cluster and the last was also tested. If the hypothesis is rejected, there is no non-response bias. As a result of the analysis, it can be confirmed that there was no gap in responses ( $p = 0.498$ ).

The hypotheses for this research was verified by various analytical methods. First, the validity and reliability of the collected data were to be tested by a factor analysis and Cronbach's alpha coefficient. There are three criteria for a factor analysis: over 0.5 in factor loading coefficients, including items in just one variable and over 1.0 in eigenvalue. The criterion for a Cronbach's alpha coefficient is over 0.6. Second, the moderating effect of LIS on IOC and performance is verified by multiple regression analysis. Therefore, this research analyses the moderating effects of LIS on IOC and performance through these processes. The results are as follows.

#### **IV. The Results of Empirical Tests**

##### *4.1. General characteristics of the responding firms*

This research tests the general characteristics of the responding firms before verifying the hypotheses. The contents are as follows. There are several characteristics. 54 firms have an annual turnover of less than US\$ 5 million, 54 firms show a turnover of between US\$ 5-100 million and 25 firms show an annual turnover over US\$ 100 million. In addition, the annual turnover is shown in a similar distribution, which suggests that varying scales of firms participated in the survey. The classification of types of business shows that liners and international shipping agents have 71 firms, which is the largest cluster. This means that they have abundant financial resources and, consequently, have the capability to use various strategies in the market. On the basis of the year founded, 55 firms were founded in the 1990s, which is the largest cluster. The number of employees also shows that 96 firms have below 50 employees, which is the largest cluster. The character shows that the responding firms are variously distributed and this means that the data collected is not biased in any part of the population.

##### *4.2. The results of reliability and validity*

To verify the reliability and validity of the collected data, this research performed a factor analysis and ascertained the Cronbach's alpha coefficient. The result is as follows. The result of LIS and IOC shows that KMO is 0.900 and Bartlett test is that chi square is 1788.041 ( $df=91$  and

p=0.000). LIS has six items and the coefficients show 0.565 to 0.840 (Cronbach's alpha=0.887; eigenvalue=3.702 and percentage of variance=26.441). Internal organizational collaboration has three items and the coefficients show 0.771 to 0.821 (Cronbach's alpha=0.899; eigenvalue=2.632 and percentage of variance=18.799). External organizational collaboration has five items and the coefficients show 0.743 to 0.865 (Cronbach's alpha=0.920; eigenvalue=3.942 and percentage of variance=28.155). The result of cost saving and service improvement shows that KMO is 0.870 and Bartlett test is that chi square is 1483.153 (df=55 and p=0.000). Cost saving has four items and the coefficients show 0.807 to 0.877 (Cronbach's alpha=0.889; eigenvalue=3.137 and percentage of variance=28.519). Service improvement has seven items and the coefficients show 0.728 to 0.889 (Cronbach's alpha=0.937; eigenvalue=5.034 and percentage of variance=45.767). Next is correlation among the variables.

**Table 1: The result of correlation analysis**

var	ave	sta	LIS	IC	EC	CO	SE
LIS	4.625	1.064	1.000				
IC	4.601	1.269	0.613***	1.000			
EC	4.394	1.221	0.628***	0.668***	1.000		
CO	4.282	1.102	0.486***	0.651***	0.570***	1.000	
SE	5.303	1.065	0.390***	0.557***	0.443***	0.437***	1.000

Notes) var: variables, ave: average, sta: standard deviation; IC: internal organizational collaboration, EC: external organizational collaboration, CO: cost saving, SE: service improvement; \*\*\*: p > 0.01

As shown in Table 1, independent variables explain dependent variables very well because the correlation coefficients are high. On the other hand, the coefficients among the independent variables are shown to be high and this means that it is possible to be multicollinearity in the relationships between the variables. That is why this research needs to test tolerance and MAX-VIF. The result is that internal organizational collaboration has 0.493 (tolerance) and 2.030 (MAX-VIF), external organizational collaboration has 0.478 (tolerance) and 2.094 (MAX-VIF) and LIS has 0.538 (tolerance) and 1.858 (MAX-VIF). As a result, there are no problems in the results. Therefore, the moderating effect of LIS on IOC and performance can be tested.

#### *4.3. Hypotheses tests*

To test the hypotheses, this research uses a multiple regression analysis and the results are as follows.

According to Table 2, the moderating effect of IOC on LIS and cost saving is confirmed (H. 1-1 supported). The coefficient of F in high LIS is higher than the coefficient of F in low LIS and the coefficient of adj R square in high LIS is higher than the coefficient of adj R square in low LIS. In addition, the moderating effect of IOC on LIS and service improvement is confirmed (H. 1-2 supported). The reason is same as H. 1-1. These results are based on below discussion.



**Table 2: The moderating effect of LIS**

vari-ables	cost saving						service improvement					
	high LIS (120)			low LIS (43)			high LIS (120)			low LIS (43)		
	t	F	adj R <sup>2</sup>	t	F	adj R <sup>2</sup>	t	F	adj R <sup>2</sup>	t	F	adj R <sup>2</sup>
cons	3.798***	39.877	0.395	2.669***	8.365	0.260	9.164***	27.544	0.308	3.954***	2.255	0.056
IC	6.002***			1.474			5.192***			1.605*		
OC	1.860**			2.639**			1.272			0.449		

Notes) \*\*\*: p < 0.01, \*\*: p < 0.05, \*: p < 0.1

#### 4.4. Discussion

The results of this research can be interpreted as follows. LIS is confirmed as a factor in enhancing the relationship between IOC and performance. International shipping and logistics firms perform IOC by LIS in supply chains and, as a result, they can achieve high performance. This is explained by fit as moderation by Venkatraman (1989). The relationship between IOC and performance is enhanced by LIS and as a result, firms make wholly efficient processes in their supply chain systems. In addition, the relationship between IOC and performance is explained by a resource-based view and the relationship between LIS and performance is also explained by a resource-based view. Prior research verified that LIS and IOC are the causal variables, followed by enhancing performance and the result of this research verified that there is the synergy effect between the two variables because the moderating effect of LIS also enhances the positive relationship between IOC and performance. In this regard, LIS plays a role in supporting information sharing. The result provides justification for the assertion that firms should invest in LIS. Prior research has ascertained that firms which have superior information systems achieve high IOC and this is connected with high performance (Green et al., 2012; Iyer, 2011; Paulraj & Chen, 2007; Williams et al., 1997). Such results provide justification for the results of this research. Therefore, the moderating effect of LIS enhances the positive relationship between IOC and performance.

#### V. Conclusion

The aim of this research is to verify the moderating effect of LIS on IOC and performance. To achieve the aim, this research used various research methods. This research used the definitions of the variables from prior research and looked at the relationships between the variables. The questionnaires responded by members of international shipping and logistics firms was used for the analysis of this research. The reliability and validity of the data were tested by a factor analysis and the Cronbach's alpha coefficient. In addition, the hypotheses of this research were verified using a multiple regression analysis. The theoretical implication has already been explained in the discussion and the managerial implications, limitations and future research directions are as follows.

The managerial implications are proposed as follows. First, the results of this research prove the moderating effect of LIS on IOC and performance. LIS is the factor which has a direct effect on performance. It also supports information sharing in supply chain partners as well as on departments and plays a role in enhancing the relationship between IOC and performance. For this reason, firms which have superior LIS can improve performance through IOC. In addition, managers grasp customer needs and disseminate the needs to organizations using superior LIS, followed by high performance. Managers structure efficient supply chain processes through IOC between organizations and improve the performance of the whole process through collaboration with the partners as well as departments (Boon-itt & Wong, 2011). The strategic choice of managers on IOC leads to a superior performance through the usage of LIS and, as a result, costs are saved and service is improved.

Second, if managers want to achieve high performance through IOC, they should grasp their current level of LIS. This provides information; such as, what strategic decision making could improve their performance? The results of this research prove the moderating effect of LIS on IOC and performance. If managers focus on the moderating effect, they can improve performance. On the basis of these results, managers can grasp a method for enhancing performance through stressing IOC and LIS together.

Despite the above implications, this research has resulted in some limitations. = First, the results show that the relationships between IOC and performance are not supported as part of the result. This has no influence on the results of this research but the results should be investigated in the future. Second, the population is international shipping and logistics firms but prior research was performed with manufacturing firms. This is one of the reasons why some parts of the results are rejected. Therefore, researchers need to find the items to fit in international shipping and logistics firms. Research on the moderating effect of LIS on IOC and performance which reflects the above limitations is made up of future research directions.

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