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The Effect of Container Shipping Supply Chain Integration on Operational Performance: The Mediating Role of Information Sharing

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Abstract

Purpose - Conventional supply chains (SCs) must identify facilitating roles, such as port/terminal operators, shipping companies, and freight forwarders in executing the various logistical activities that support the organizational strategies of shippers. Meanwhile, supply chain collaborative practices can facilitate the willingness to share relevant and mutually helpful information. To this end, this study seeks to identify the impact of supply chain integration (SCI) on the IS and operational performance (OP) of the container-shipping industry in Korea with social capital perspectives.

Design/Methodology - Based on previous studies, we established the research model for this study. The survey administration yielded 149 valid responses from employees working in liner-shipping companies and freight forwarders in Korea. With the collected questionnaires, hypotheses test were carried out using SPSS 26.0 and AMOS 26.0

Findings – The results indicate the existence of a mediated relationship wherein the impacts of SCI on OP is mediated by IS. The effect of external integration (EI) on OP is fully mediated by information quality (IQ) and information-sharing contents (ISC). EI, IQ and ISC partially mediate the relationship between internal integration (II) and OP.

Originality/value - This study expands SCI contexts, wherein ISC and IQ respectively serve as bridges between EI and OP. This has crucial implications for container-shipping companies in terms of improving their performance.

Keywords: Container shipping supply chain, container-shipping industry, information sharing, supply chain integration, operational performance

1. Introduction

Maritime transport plays a pivotal role in global supply chains (SCs). Since the manufacturers in SCs are more inclined to choose maritime transport for their export and import activities, shipping has contributed to promoting globalization in several industries. Additionally, achieving excellence in improving maritime operations toward successful logistics integration enhances the performance of entire logistics entities (Lee Eon-Song and Song Dong-Wook, 2010). Therefore, conventional SCs must identify facilitating roles, such as port/terminal operators, shipping companies, and freight forwarders in executing the various logistical activities that support the organizational strategies of shippers (Yuen et al., 2019).

In the case of container-shipping, order and information processing are crucial activities for supply chain integration (SCI) (Lam, Meersman and Van de Voorde, 2012). Sharing information between diverse entities plays a key role in guaranteeing amicable maritime SC operations and management as the degree of interconnection in maritime logistics increases (Lam and Zhang, 2014). However, information distortion and retention issues can sometimes occur in SCs since individual entities only focus on their respective goals and objectives, which can increase the total logistics costs. For instance, in the shipping industry, shippers and logistics service providers (LSPs) tend not to share crucial information since the recipients of such information may improperly reveal it to opponents or damage profits by misusing it (KMI, 2019). Moreover, Siemieniuch, Waddell and Sinclair (1999) found that SC collaborative practices can facilitate the willingness to share relevant and mutually helpful information. Thus, building a high level of trust in improved LSPs is necessary to foster the willingness of shippers and service providers to share crucial information. Furthermore, information sharing (IS) has various functions in SCs and is concerned with not only sharing information but also when, how, and whom it can affects in different ways (Holmberg, 2000). Hence, both information sharing contents (ISC) and information quality (IQ) should be considered in IS.

However, while the research regarding IQ in the manufacturing industry is insufficient (Sagawa and Nagano, 2015), there is also a lack of research that analyzes IQ in the container-shipping industry. Moreover, today, competition mainly occurs between SCs in the business world (Lam and Van De Voorde, 2011), which means that SCI has been established to some extent. Therefore, it is advisable to focus strategies on the pursuit of a high degree of consistency between supply chain management (SCM) and competitive strategies (Kim Soo-Wook, 2009). Hence, this study aims to identify the impact of SCI on IS and operational performance (OP) in the container-shipping industry in Korea. This study defines “container-shipping companies” as liner- shipping companies and freight forwarders (Yuen and Thai, 2016; Tseng and Liao, 2015). Liner-shipping companies operate shipping vessels and are directly engaged in container-cargo maritime transportation. Freight forwarders consolidate the shipping process on behalf of ocean carriers and provide logistical services to shippers. Furthermore, this study examines the mediating effects of all exogenous variables to explore the direct, indirect, and total effects of these variables on the endogenous variables.

Since the objectives and proprietary information of information-sharing firms are factors that are linked to the social relationships associated with SCI (Jacobs, Vickery and Droge, 2007) and social capital theory explores external activities from a social-relationship perspective (Lawson, Tyler and Cousins, 2008). Hence, this study investigates SCI by using a social capital theory lens. To the best of our knowledge, only Lin, Potter and Pettit's (2021) study adopted the social capital perspective for the maritime logistics industry. Hence, this study examines the SCI in terms of IS volume and quality.

The remainder of this study is organized as follows: Section 2 presents the literature review, which examines the concepts of social capital theory and SCI, SCI and IS, IS and OP, and discusses the uniqueness of this research. Section 3, discusses the survey-questionnaires designs, based on previous studies, and presents the research model. Additionally, this section discusses how the survey was administered. The factor analyzes and structural equation modeling (SEM) results are presented in Section 4. Finally, Section 5 summarizes the results, implications, limitations and future research directions to conclude this study.

2. Literature Review

2.1. Social Capital Theory and SCI

In SCs, social capital can be defined as an assemblage of the social assets and structures involved in the relationships of a supply chain entity (Min Soon-Hong, Kim Stephen K. and Chen, 2008). According to social capital theory, social capital can provide access to crucial information that can be used to improve performance. (Luk et al., 2008). Since the relationships across an SC refers to the relationships among social actors, recent studies have applied the concept of social capital in the field of SCM (Chen et al., 2018; Wu and Chiu, 2018). Social capital can be categorized into structural, cognitive, and relational structures (Li, Ye and Sheu, 2014). These three types of capital coincide with factors related to SCI (Jacobs, Vickery and Droge, 2007, 2007; Chavez et al., 2015). Specifically, Koka and Prescott (2002) argued that buyer-supplier relationships are social structures that allow companies to exchange information that can improve information quality and thus, should also be considered as social asset.

SCI can mitigate the risks between buyers and suppliers as well as enhance the richness and flow of information (Cousins and Menguc, 2006). Moreover, OP can be improved through the interaction of SCI and IS (Cousins and Menguc, 2006). Therefore, this study utilizes social capital theory and examines social structures from an SCI perspective.

2.2. SCI and Performance

Successful SCM requires the integration of entities to produce a cooperative and collaborative environment that facilitates shared decision-making and information exchange across an SC (Berry et al., 1999). Thus, SCM philosophy highlights SCI, which connects a company with its customers and suppliers.

Container-shipping forms an essential part of the SC in handling and carrying cargoes across the sea (Yang and Wei, 2013). The container-shipping SC incorporates shipping lines, ports, and inland transport services; thus, in this case, port-to-port services are extended to door- to- door services. The main participants of the container-shipping SCI are shippers, freight forwarders, shipping carriers, port/terminal operators, and the diverse value-added activities that agents perform to benefit consignees (Yang, 2016). If maritime transportation is not properly integrated into the overall logistical flows, it can lead to extra costs, needless delays, and accidents, which can lead to logistical flow distortion. Yuen and Thai (2017a) summarized the benefits of SCI in the maritime logistics industry as complementary demand generation, creation of operational synergies, business diversification, lower transaction costs, access to new markets, and service quality enhancement. Consequently, a container-shipping SC can be defined as "the connected series of activities pertaining to shipping services which is concerned with planning, coordinating and controlling containerized cargoes from the point of origin to the point of destination" (Lam, 2013). Therefore, the suppliers of container-shipping companies are terminal operators, while their customers are shippers.

Flynn, Huo and Zhao (2010) stated that SCI can be conceptualized as a unidimensional construct, a multidimensional construct, a utilization level, and a direction of integration. SCI is most frequently represented by its direction of integration. Since both supplier integration (SI) and customer integration (CI) entail consolidating with SC partners, they can be united into a single construct (Germain and Iyer, 2006; Lockstrom et al., 2010). Hence, SCI can be conceptualized as two key dimensions: internal integration (II) and external integration (EI) (Leuschner, Rogers and Charvet, 2013). II refers to the extent to which a firm can organize its systematic strategies, procedures, practices, and behaviors into synchronized, collaborative, and manageable processes to satisfy customer requirements (Lin and Chen, 2008). Meanwhile, EI refers to companies' working with key SC members (customers and suppliers) to organize strategies, procedures, practices, and behaviors into synchronized, collaborative, and manageable procedures to achieve customer requirements (Huo, 2012).

Regarding SCI in the container-shipping industry, Tseng and Liao (2015) surveyed the relationship between SCI, market orientation, IT application, and firm performance in Taiwan's container transportation industry. They found that the application of IT had no direct effect on firm performance, but it influenced firm performance through market orientation and SCI. Moreover, SCI played a partial mediating role in the relationship between market orientation and firm performance. This study analyzed the effect of SCI on performance in terms of the unidimensional aspect of SCI and its mediating role. On recent studies, scholars adopt multidimensional aspect of SCI, Thai and Jie

(2018) adopted a multiple regression analysis to analyze the impact of total quality management on SCI and the financial and non-financial performance of the container-shipping industry. They concluded that it was worthwhile to focus on II to improve service quality in the shipping industry, while only SI had a significant effect on financial performance. Furthermore, Yuen et al. (2019) identified five critical success factors (relationship management, information management, organization management, strategic management, and performance management) for the container-shipping industry based on the resource-based view theory and further examined the effects of these critical success factors and SCI on supply chain performance (SCP) were examined. They observed that EI played a partially mediating role in the influence of II on SCP. Between II and EI, the latter had a slightly greater impact on performance; however, both these dimensions are important because their impact differential is small.

Existing studies mainly analyze the mediating effect of supply chain integration and to find enablers and drivers for supply chain integration. In other words, the main objective of these papers was to understand the mediating role of SCI. However, the effect of SCI on performance was not consistent across studies. Accordingly, this study contributes to compare the differences with other studies and to resolve the inconsistencies.

2.3. SCI and IS

IS represents the degree to which the exchange of critical information among SC members can facilitate cooperation among companies (Zhou and Benton, 2007). Companies can acquire significant benefits through effective IS with SC entities (Li and Lin, 2006; Li, Ye and Sheu, 2014). For proper IS, it is important for the SC members to share their overall SCM goals and objectives with each entity in the SC (Lambert and Cooper, 2000).

Maritime transport market conditions (cargo and ship supply/demand, oil prices fluctuations) tend to fluctuate monthly and yearly (Kim Jun-Seung et al., 2020). However, sharing important strategic information only occurs when there is a high degree of confidence that such information will not be used inappropriately (Klein and Rai, 2009). Therefore, information confidentiality must be ensured and SC members must undertake the responsibility of controlling the flow of information. Building a high level of trust in improved LSPs is necessary to foster the willingness of shippers and service providers to share crucial information. To encourage SC partners to exchange crucial information, enhanced LSPs must clearly demonstrate their capabilities in coordinating knowledge or information and creating greater value for the entire SC (Randall, Pohlen and Hanna, 2010). Enhanced LSPs can adjust all related information to meet the demands of their SC partners such as ports, customs, authorities, etc. To encourage relevant entities to share sensitive information, improved LSPs should be recognized and supported by SC members by demonstrating to the industry that IS can help the SC and produce win–win results for all parties involved. The type of IS tends to be segmented to transactional, strategic, and feedback information, which is typically shared between shippers, service providers, and enhanced LSPs (Lam and Zhang, 2014). Transactional information refers to basic transaction-related information that must be shared such as schedules, routes, freight charges, and frequency. Additionally, real-time tracking information related to vessel or cargo positions is often provided by service providers. Regarding strategic information, LSPs should be allowed access to strategic information such as production schedules, sales and inventory levels, and marketing strategies through an agreements with shippers. Regarding feedback information, in a dynamic environment, the information and performance criteria of the framework should be continuously updated and revised, and improved LSPs should promote various entities in the framework to provide feedback for further enhancing performance.

Moreover, IS can be viewed from the quantitative and qualitative perspectives (Zhou and Benton, 2007). The quantitative aspect of IS refers to the amount of information shared, while the qualitative aspect relates to the type of information actually shared between SC partners (Williams et al., 2013). The importance of IS relies on when, how, and what is exchanged (Li and Lin, 2006). Hence, both ISC and IQ should be considered. IQ is defined as the information abundance that stresses the quality and information characteristics shared between buyers and suppliers (Koka and Prescott, 2002; Zhou and Benton, 2007). Salaün and Flores (2001) argued that IQ is the degree to which user requirements are met in respect of user interest and freshness. The main characteristics of IQ are usefulness, accuracy, reliability, reduced uncertainty, clarity regarding objectives, and timeliness (Hong Paul et al., 2004; Youn Sun-Hee, Hong Paul, Nahm Abraham, 2008). Through their positive experiences with the quality of IS, decision-makers may seek to share more information with each other. Therefore, for high-quality IS, a close relationship among the SC participants is required.

While several studies have explored the impact of IS on SCI (Sundram, Chhetri and Bahrin, 2020; Panahifar et al., 2018; Afshan, Chatterjee and Vhhetri 2018), some have examined the relationship between SCI and IS. Koçoğlu et al. (2011) analyzed the effects of SCI on IS and SCP for manufacturing companies in Turkey and found that IS partially mediates the relationship between SCI and SCP. Despite this result, Asamoah, Andoh-Baidoo and Agyei-Owusu (2016), in a study replicating Koçoğlu of et al.’s (2011) study, found that IS fully mediates the SCI-SCP relationship. Chavez et al. (2015) surveyed 225 manufacturing companies in Ireland to determine whether IQ mediates the relationship between CI and OP. Their findings revealed that, at a confidence level of 95% of p-value, the impact of CI on quality and flexibility were partially mediated by IQ. Moreover, the influence of CI on cost and delivery is fully mediated by IQ. Baihaqi and Sohal (2013) investigated how integrated IT, II, IQ, and costs–benefits sharing can affect the degree of IS in an SC. IQ and integrated IT were found to have a positive effect on IS intensity, but II and costs–benefits sharing did not affect the degree of IS. This is either because the data was insufficient to observe this relationship, or the items used in the survey did not adequately recognize II. Li and Lin (2006) investigated the effect of environmental uncertainty, intra-organizational facilitators, and inter-organizational relationships on IS and IQ in SCM. The results of multiple regressions indicated that IS and IQ were influenced positively by the inter-relationship of trust and shared vision. Top management, which is an intra-organizational facilitator, was found to have a positive impact on IS but a marginal effect on IQ.

2.4. IS and Performance

IS plays an important role in value creation. For example, information distortion phenomena can be prevented by sharing information with other firms. This can reduce the bullwhip effect and costs, improving SCP (Li, Ye and Sheu , 2014). IS leads to reduced SC costs, increased material flow, faster delivery, enhanced channel coordination and an increased order fulfillment rate, which leads to customer satisfaction and facilitates the achievement of a competitive advantage (Koçoğlu et al., 2011). Moreover, IS enables companies to make an optimal choice concerning capacity allocations, ordering, production, and material planning (Cheng, 2011). It serves as an important driver for companies to enhance their knowledge-base and thus, provides them with all possible benefits to maximize profits across the collective system (Ding, Guo and Liu, 2011). Moreover, IS increases transparency and leads to beneficial relationships, helping SC partners to overcome their fear of information disclosure and loss of power to competitors (Zhou and Benton, 2007). When firms share accurate and timely information with suppliers, effective production schedules and inventory arrangements can be made. Consequently, coordinated goal achievement, reduced production and inventory costs, and decreased market lead times can be achieved. Additionally, SC efficiency and effectiveness can be significantly enhanced through the timely and accurate use of information in decision-making and the constant flow of information across the entire SC.

Fawcett et al. (2007) discovered that both connectivity and IS willingness positively affect OP and are crucial for developing the real IS ability of an SC. Moreover, they found that a majority of companies tend to focus on connectivity, often ignoring the structure of their IS willingness. Chen et al. (2019) investigated the relationship among IS, SCI, OP, and business performance and found that IS is crucial to improving the relationship between SCI and OP, and both SCI and OP acted as mediators for the effect of IS' on the business performance of fashion brands. Wu, Chuang and Hsu (2014) regarded trust, commitment, reciprocity, and power as key social exchange factors and investigated whether they promote IS and collaboration using partial least squares (PLS)-SEM. They found that SC collaboration partially mediated the relationship between IS and SCP. However, PLS-SEM does not analyze model-fit, only the its path. Marinagi, Trivellas and Reklitis (2015) investigated the relationship between IS, IQ, and performance. They found that IS fully mediates the relationship between IQ and SCP. Meanwhile, the direct effect of IQ on SCP was also observed.

Many studies have analyzed the effect of SCI on performance, IS on SCI, and IS on performance. However, the research investigating the effect of SCI on ISC and IQ is insufficient. Despite the numerous studies on IS, most have been centered on manufacturing companies, and thus, there is a lack of research on IS in the container-shipping industry. Research on IQ is still insufficient in relation to manufacturing (Sagawa and Nagano, 2015), and thus, no attempts have been made to analyze IQ in the maritime industry context. Moreover, no studies have attempted to determine the influence of SCI on IS, in terms of ISC and IQ, in the shipping industry.

Most studies have analyzed the effect of ISC and IQ on SCI; however, some studies have suggested that SCI has a significant effect on ISC and IQ as well. This study addresses this gap in the literature. Additionally, most previous studies have shown that SCI directly affects performance; however, Asamoah, Andoh-Baidoo and Agyei-Owusu (2016) found that IS fully mediates the relationship between SCI and performance. Also, considering that the result of SCI on performance is inconsistent among studies, a missing link seems exist. Therefore, this study aims to investigate the effect of SCI on ISC, IQ, and performance.

Financial criteria were excluded due to its narrow concentration and failure to consider the entire SCP (Yuen et al., 2019). Competition mainly occurs between SCs in the business world (Lam and Van De Voorde, 2011), not among organizations. Hence, to become globally competitive, it is crucial to involve entities and performance should be evaluated based on the supply chain level. Additionally, the effect of SCI on financial performance was found to be invalid (Huo, 2012) or almost non-existent (Thai and Jie, 2018). Thus, OP is the most suitable for this study measuring SCI.

Since the effect of II on IQ has not been studied before, the current study analyzed this relationship as well. Moreover, since some studies have indicated that II has a significant effect on EI (Yang, Yeo Gi-Tae and Vinh, 2015; Yuen and Thai, 2017b), the current study further aims to discern the presence of a mediation effect in this relationship. Based on the above discussion, this dissertation postulates the following hypotheses:

H1: II has a positive effect on OP.

H2: EI has a positive effect on OP.

H3: II has a positive effect on ISC.

H4: II has a positive effect on IQ.

H5: EI has a positive effect on ISC.

H6: EI has a positive effect on IQ.

H7: ISC has a positive effect on OP.

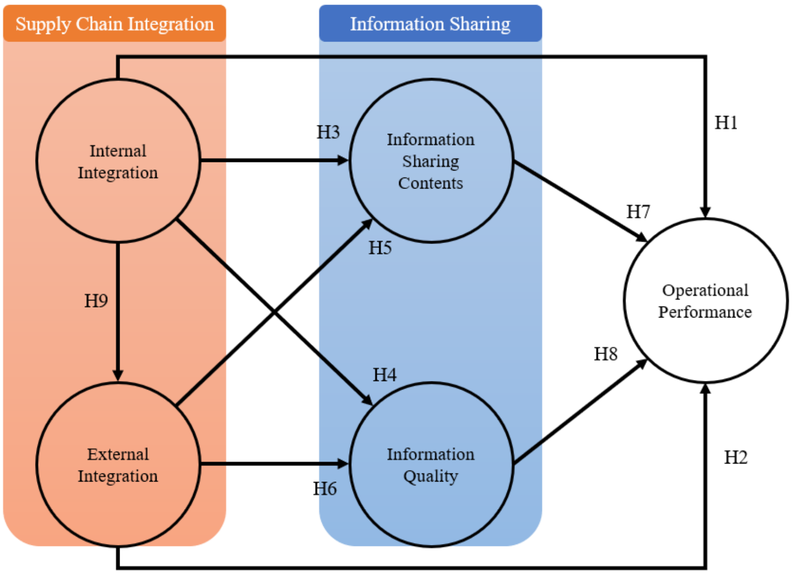
H8: IQ has a positive effect on OP.

H9: II has a positive effect on EI.

3. Research Methodology

3.1. Research Design

Fig. 1. Research Model



Based on previous studies, the research model for this study was established as shown in **Fig. 1**. In this study, the measurement items are were developed based on the previous literature. Additionally, operational definitions were developed for the construct validity for the II, EI, ISC, IQ, and OP. The scales, measurement items, and sources used to develop the survey items are shown in **Table 1**.

Table 1. Constructs, Measurement Items, and Adapted Sources

Construct	Code	Measurement items	Source

Internal Integration	II1	Balancing functional trade-offs within the company	Yuen et al. (2019); Thai and Jie (2018)
	II2	Investing in intra-firm information systems	
	II3	Using compensation, incentive and reward systems	
	II4	Using cross-functional teams in process improvement	
	II5	Degree of periodic interdepartmental meetings	
	II6	Extent of interdepartmental project technology and operational decisions are made	
	II7	Responsiveness within the company	
External Integration	EI1	Extending organizational power and knowledge to supply chain partners	Yuen et al. (2019); Huo (2012); Chavez et al., (2015)
	EI2	Investing in interfirm information systems	
	EI3	Jointly develops responsibilities	
	EI4	Establishing an operation plan collaboratively	
	EI5	Degree of effort made to help in case of an emergency	
	EI6	Meeting mutual requirements	
	EI7	Frequency of periodic contact	
	EI8	Degree of participation in the work-improvement process	
Information-sharing Content	ISC1	Supply and demand forecasts	Chen et al. (2019); Wu, Chuang and Hsu (2014); Lam and Zhang, (2014)
	ISC2	Performance metrics	
	ISC3	shipment and cargo tracking	
	ISC4	Inventory management	
	ISC5	Marketing-strategy information	
Information Quality	IQ1	Timeliness	Li, Ye and Sheu (2014); Zhou and Benton (2007)
	IQ2	Accuracy	
	IQ3	Completeness	
	IQ4	Adequateness	
	IQ5	Reliability	
	IQ6	Easy accesses	

Operational Performance	OP1	On-time delivery record	Flynn, Huo and Zhao (2010)
	OP2	Degree of responsiveness to changing market demands	
	OP3	Lead time	
	OP4	Customer-service level	
	OP5	Cost of producing products/services	

3.2. Survey Design and Data Collection

All survey questions were measured using a five-point Likert scale as follows: “very low” (1 point), “low” (2 points), “normal” (3 points), “high” (4 points), “very high” (5 points). Since previous studies were in English, some modifications were made to the current study to enhance the understanding of respondents after the items were translated into Korean.

To collect the data, the created measurement items were incorporated into a survey. The survey questionnaire was divided into three parts: the background and purpose of this study, the measurement items, and the respondents’ demographic characteristics and firms’ characteristics. First, the basic information of author and the current study’s purpose were introduced. Next, a short introduction to SCI in the shipping industry was provided. The respondents were assured that their answers would remain confidential. Next, the respondents were requested to evaluate each measurement item using the provided Likert scale. Lastly, information regarding the demographic characteristics of the respondents and their firms, including the names of their firms, their job title, years of tenure, department, company type, main business area, number of employees, and annual revenue, were acquired.

For liner-shipping companies, this study targeted the top 100 enterprises listed on Alphaliner with business branches in Korea, and for freight forwarders, the companies listed on Korea International Freight Forwarder Association were targeted. The survey was conducted online by distributing questionnaires via email.

3.3. Demographics of Respondents

A total of 696 surveys were randomly distributed to employees working in shipping companies and freight forwarders and 158 questionnaires were collected, showing a 22.7% response rate. The survey was conducted from September 8, 2020 to November 9, 2020. Among the questionnaires, 149 responses copies were finally used, excluding 9 that were incomplete or had otherwise unreliable responses. **Table 2** presents the demographic characteristics of the 149 respondents. The sample comprised respondents from 54 liner-shipping companies and 95 freight forwarders. Since the respondents held at least five years of working experience (about 70%) and occupied managerial roles (about 75%), they can be seen as a representative sample of industry groups in answering the survey questions.

Table 2. Respondents' Demographic Characteristics

Company type	**n**	**%**
Foreign Shipping Liners	30	20.13%
Korean Shipping Liners	24	16.11%
Shipping (Total)	54	-
Local Freight Forwarders	49	32.89%
Conglomerate Freight Forwarder	35	23.49%
Foreign Freight Forwarder	11	7.38%
Freight forwarder (Total)	95	-
Business area	**n**	**%**
North America	31	20.80%
Europe Union	28	18.79%
South-East Asia	50	33.56%
Japan and China	35	23.49%
Others	5	3.36%
Total	149	100%
Job title	**n**	**%**
Staff	36	24.16%
Assistant Manager	37	24.84%
Manager	33	22.15%
Deputy General Manager	19	12.75%
General Manager	12	8.05%
Director And Above	12	8.05%

Total	149	100%
Year of tenure	**n**	**%**
< 5 years	50	33.56%
< 5~10 years	38	25.50%
< 10~15 years	25	16.78%
< 15~20 years	21	14.09%
> 20 years	15	10.07%
Total	149	100%
Department	**n**	**%**
Sales	54	36.24%
Operation/Support	86	57.72%
Human Resource/General Affair	2	1.34%
Finance/Accounting	7	4.70%
Total	149	100%

4. Result and Discussion

4.1. Measurement Model Analysis

4.1.1. Exploratory Factor Analysis

Cronbach's α was used in this study to measure whether the results met the internal consistency requirements. Cronbach's α has a value between 0 and 1, and the higher the value, the more reliable it is. The recommended criterion for each factor was above 0.7 (Kline, 2010). The measurement variables and the values of the Cronbach's α factor values are shown in **Table 3**.

Table 3. Values of Cronbach's α

Factor of Evaluation		Cronbach's α if item deleted	Cronbach's α
	II1	0.769	
II	II2	0.762	0.795
	II3	0.782	

	II4	0.770	
	II5	0.786	
	II6	0.746	
	II7	0.764	
EI	EI1	0.787	0.802
	EI2	0.790	
	EI3	0.778	
	EI4	0.761	
	EI5	0.770	
	EI6	0.772	
	EI7	0.798	
	EI8	0.782	
ISC	ISC1	0.732	0.807
	ISC2	0.748	
	ISC3	**0.841**	
	ISC4	0.749	
	ISC5	0.761	
IQ	IQ1	0.860	0.881
	IQ2	0.848	
	IQ3	0.855	
	IQ4	0.857	
	IQ5	0.870	
	IQ6	0.871	
OP	OP1	0.805	0.856
	OP2	0.833	
	OP3	0.809	
	OP4	0.810	
	OP5	**0.870**	

All the Cronbach's α values are over 0.7. The Cronbach's α coefficient of SCI was 0.795 for the II factor and 0.802 for the EI factor. The Cronbach's α coefficients of ISC and IQ were 0.807, and the IQ was 0.881, respectively. Lastly, the Cronbach's α coefficient of OP was 0.857. All variables showed very strong relationship with values of 0.7 or more. However, two items were removed since their Cronbach's α coefficient increases to 0.841 and 0.870 respectively when items IS3 in ISC and OP5 in

OP were deleted.

The validity of a measurement model depends on whether the means for measuring the properties of a latent variable accurately represents the property. In this study, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were conducted to verify the validity of the measurement model. EFA is a dimension-decreasing technique used to identify the basic structure of a large set of variables and identifies the relationships between measured variables. The fundamental dimensions of II, EI, ISC, IQ, and OP were obtained using principal component analysis and VARIMAX rotation because the measurement items were derived from more than two studies. VARIMAX is usually believed to be greater than other orthogonal factor rotation techniques for achieving a simplified factor structure (Hair et al., 2006). Furthermore, it is appropriate to perform factor analysis when the eigenvalue is 1 or more (Churchill and Iacobucci, 2002) and the Kaiser-Meyer-Olkin (KMO) value, which indicates whether the number of variables used in factor analysis and the number of case data is appropriate, was 0.5 or more (Kaiser, 1974).

During data reduction, items with factor loadings of less than 0.50 (Hair et al., 2006) and items with collinearity were deleted individually until an ideal factor table was reached. As shown in **Table 4**, eight items (II5, II6, II7, EI1, EI2, EI3, EI4, EI8) were deleted. The other factors had an eigenvalues range of 7.730~1.248. The factor-loading values ranged from 0.818 to 0.607, and the explanatory power of each of the variables were 36.808%, 9.59%, 8.361%, 6.727% and 5.944%. Additionally, the result of the KMO test for the variables was 0.884, meeting the suggested criteria of 0.5. Thus, the items presented on the measurement scale were appropriate for measuring the variables presented in the model.

Table 4. Exploratory Factor Analysis for Supply Chain Integration, Information Sharing, and Operational Performance

Contents	Items	Components				
		1	2	3	4	5
Information Quality	IQ2	**0.818**	0.072	0.184	0.036	0.213
	IQ4	**0.813**	0.116	0.143	0.014	0.039
	IQ3	**0.780**	0.194	0.191	0.058	0.032
	IQ5	**0.698**	0.020	0.192	0.092	0.208
	IQ1	**0.685**	0.308	0.147	0.242	0.113
	IQ6	**0.607**	0.306	0.112	0.133	0.252
Information-	ISC2	0.168	**0.806**	0.102	0.047	0.131

Sharing Contents	ISC1	0.059	**0.796**	0.195	0.165	0.254
	ISC5	0.310	**0.781**	0.098	0.084	-0.093
	ISC4	0.175	**0.683**	0.340	0.102	0.090
Operational Performance	OP3	0.255	0.161	**0.810**	0.104	0.140
	OP4	0.202	0.139	**0.767**	0.188	0.250
	OP1	0.353	0.192	**0.754**	0.189	0.023
	OP2	0.106	0.224	**0.714**	0.194	0.180
Internal Integration	II3	0.036	0.210	0.068	**0.770**	-0.046
	II2	0.142	-0.088	0.079	**0.744**	0.243
	II4	0.028	0.134	0.160	**0.739**	-0.043
	II1	0.169	0.076	0.262	**0.620**	0.161
External Integration	EI7	0.104	0.021	0.223	-0.011	**0.787**
	EI5	0.223	0.222	0.112	0.137	**0.767**
	EI6	0.441	0.138	0.168	0.188	**0.621**
Eigenvalues		7.730	2.014	1.756	1.413	1.248
% Cumulative		36.808	46.398	54.759	61.486	67.430
		KMO				0.884
Bartlett's Test of Sphericity			Chi Square		1559.319	
			df(p)		210 (P<0.000)	

4.1.2. Confirmatory Factor Analysis

In this study, CFA was conducted to measure the validity and reliability of the results and to evaluate the overall model fit. The measurement items' standardized factor loadings (λ), t-values, average variance extracted (AVE) values, and composite reliability (CR) values of the measurement scale are presented in **Table 5**.

Table 5. Results of Confirmatory Factor Analysis, Average Variance Extracted, and Composite Reliability

Construct	Item	λ	T-value	AVE	CR
Internal Integration	II1	.655	-	0.418	0.742
	II2	.641	5.885		

	II3	.654	5.959		
	II4	.637	5.860		
External Integration	EI5	.731	-	0.515	0.756
	EI6	.835	8.141		
	EI7	.559	6.097		
Information-sharing Content	IS1	.755	-	0.611	0.862
	IS2	.835	9.384		
	IS4	.781	8.809		
	IS5	.752	9.038		
Information Quality	IQ1	.673	-	0.538	0.874
	IQ2	.682	10.267		
	IQ3	.801	9.561		
	IQ4	.769	9.165		
	IQ5	.725	8.121		
	IQ6	.742	8.239		
Operational Performance	OP1	.823	-	0.632	0.872
	OP2	.714	9.287		
	OP3	.826	11.179		
	OP4	.811	10.929		

Note: Model fit indices: $\chi^2= 270.826$ *(*$p<0.05$*,* $df=179$*);* $\chi^2/df=1.513$*; CFI=0.936; TLI=0.925; RMSEA=0.059; SRMR=0.0616*

To evaluate the model, the Tucker Lewis index (TLI), the comparative fit index (CFI), the standardized root mean square residual (SRMR), and the root mean square error of approximation (RMSEA) were estimated for the measurement model. **Table 6** presents the criteria for each standard. The results for the measurement model fit indices are presented in **the note of Table 5**. Hu and Bentler (1999) stated that the SRMR should be less than 0.80, while Browne and Cudeck (1993) mentioned that the RMSEA should be less than 0.08. Bentler (1990), along with Bentler and Bonett (1980) recommended that CFI and TLI values should be greater than 0.9, respectively. Additionally, Marsh and Hocevar (1985) stated that the chi square/degrees of freedom should be less than 3 (see **Table 6**).

Table 6. Criteria and Sources for Fit Measures

Contents	Criteria	Source

TLI	>0.9	Bentler and Bonett (1980)
CFI	>0.9	Bentler (1990)
SRMR	<0.08	Hu and Bentler (1999)
RMSEA	<0.08	Browne and Cudeck (1993)
Chi Square / Degrees of freedom	<3	Marsh and Hocevar (1985)

Source: Kwahk Kee-Young (2019), Revised by author

Since the criteria of the above studies were met, the CFA result of this study indicates a good level of fitness. The CR was calculated to evaluate the reliability of the measurement items. As shown in **Table 5**, the constructs' CRs, ranging from 0.734 to 0.895, were greater than the allowable threshold of 0.7 (Hair, 2010). The measurement validity was determined by assessing the convergent and discriminant validity of the constructs.

Table 7. Criteria and Sources for Fit Measures

	Mean	SD	II	EI	IS	IQ	OP
II	3.386	0.750	**0.418**[a]	0.187[c]	0.151	0.138	0.279
EI	3.808	0.675	0.433[b]	**0.515**	0.225	0.444	0.338
IS	3.215	0.833	0.389	0.474	**0.611**	0.275625	0.316
IQ	3.387	0.663	0.371	0.666	0.525	**0.538**	0.367
OP	3.582	0.706	0.528	0.581	0.562	0.606	**0.632**

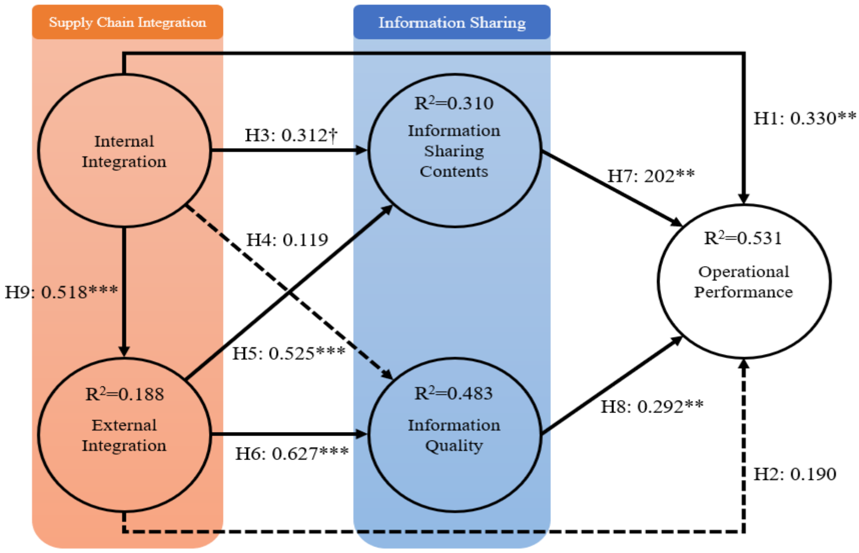
[a] AVE values are along the main diagonal; [b] Correlations between constructs are below the main diagonal; [c] Squared correlations between constructs are above the main diagonal.

First, the benchmark for AVE to meet convergent validity is 0.5 (Kline, 2010). However, as shown in **Table 7**, the construct of II was less than 0.5. Regarding this scenario, Fornell and Larker (1981) noted that, even if the AVE is less than 0.5, if the CR is greater than 0.7, the construct is valid (Lam, 2012). Moreover, if all items' t-values are greater than 2.0 and each λ is larger than 0.5, then their convergent validity is secured. This means that measurement items properly correlate with their assigned constructs. Lastly, each AVE construct is was higher than its square correlation, meaning that the measurement items and loaded structure were more relevant than the other items. Thus, discriminant validity is was confirmed.

4.2. Structural Model Analysis

After evaluating the measurement model, the structural model was tested. **Fig. 2** displays the overall structural model estimation of the research hypotheses using AMOS 22.0. All the estimations were standardized.

Fig. 2. Structural Estimation of the Research Model



Notes: Model fit indices: χ^2 = 277.843 (p<0.05, df=180); χ^2/df=1.544; CFI=0.932; TLI=0.921; RMSEA=0.061; SRMR=0.0697 (†: p<0.1; *: p<0.05; **: p<0.01; ***: p<0.001)

As noted in the note under **Fig. 2**, the structural model has a good fit (χ^2/df= 1.544 (p<.05); CFI=0.932; TLI=0.921; RMSEA=0.061; SRMR=0.0697). The endogenous variables (i.e., EI, ISC, IQ, and OP) had squared multiple correlations (R^2), with the explanatory power of the exogenous variables being 0.188, 0.310, 0.483, and 0.531 respectively.

SCI, i.e., II and EI both had a positive influence on OP at 0.33 and 0.19, respectively. However, while EI did not have a significant effect on OP, II and EI had positive and significant effects on ISC. Moreover, both II and EI had a positive influence on IQ, but the effect of II IQ was not significant. Their standardized effects were 0.312, 0.525, 0.119, and 0.627, respectively. Therefore, H1, H3, H5 and H6 are accepted. Overall, II and EI explain 31% of the variance in ISC (=0.310) and 48.3% of the variance in IQ (=0.483). These results are consistent with the argument of the current dissertation that the EI employed by the shipping companies and freight forwarders can lead to the creation of ISC and IQ.

According to **Fig. 2**, ISC also had a significant, positive effect on OP. The standardized effect was

0.202. Thus, H7 is accepted. Furthermore, IQ had a significant, positive effect on OP; the standardized effect was 0.292. Thus, H8 is accepted. These attributes explain 53.1% of the variance in trust (= 0.531). Moreover, II had a significant, positive effect on EI, with a standardized effect of 0.518. Hence, H9 is accepted, with an explanatory power of 18.8% (=0.188).

4.3. Mediation Analysis: Direct, Indirect and Total Effects Analysis

The mediating effects were examined to explore the direct, indirect, and total effects of all exogenous variables on endogenous variables. The impacts of the exogenous variables on the endogenous variables are listed in **Table 8**.

Table 8. Direct, Indirect and Total Effects

Exogenous (x) / Endogenous (y)	Total effects (c) (direct effect (a), indirect effect (b))			
	II (x=1)	EI (x=2)	ISC (x=3)	IQ (x=4)
EI (y=1)	0.518 (0.518, .000)			
ISC (y=2)	0.584 (0.312, 0.272)	0.525 (0.525, .000)		
IQ (y=3)	0.444 (0.119, 0.325)	0.627 (0.627, .000)		
OP (y=4)	0.675 (0.330, 0.345)	0.478 (0.190, 0.289)	0.202 (0.202, 0.000)	0.292 (0.292, 0.000)

Regarding the direct effects, the only predictor of EI was II (a11=0.518). Regarding ISC, the main predictor is EI (a22=0.525), followed by II (a12=0.312). The key predictors of IQ were EI (a22=0.627), followed by II (a12=0.119). Lastly, regarding operational performance, the key predictor was II (a14=0.330), followed by IQ (a44=0.292), ISC (a34=0.202), and EI (a24=0.190). However, as shown in **Fig. 2**, II does did not have a direct significant meaning effect on to IQ, and EI also does did not have a direct significant influence impact on OP.

Regarding the indirect effects, II (b14=0.345) had a stronger influence on OP than EI (b24=0.289) did. Additionally, II had an indirect effect on IQ (b13=0.325) and ISC (b12=0.272). As shown in **Fig. 2**, the effect of II on OP was partially channeled through EI, IQ, and ISC.

Regarding the total effects, II had the largest total effect (c14=0.675) on OP. Subsequently, EI had the second-largest total effect (c24=0.478), followed by IQ (c44=0.292), and ISC (c34=0.202). This analysis shows that EI had no significant direct effect on OP. However, it did have a significant indirect effect on OP. In other words, IS and IQ fully mediate the relationship between EI and OP. Additionally, EI and, IQ and IS partially mediated the influence of II on OP.

4.4. Discussion

The outcomes of this study helps to understand the relationship between SCI, IS, and OP. First, the empirical results suggest that better II enhances SCs. This result is consistent with the findings of earlier research (Yuen et al., 2019; Thai and Jie, 2018) and confirms that the integration between departments can help to improve OP. Regarding the practices related to promoting the II of shipping companies, Ji, Sui and Wang (2019) suggested some methods to strengthen II as follows: regular communication, the establishment of cross-functional department teams, coordination of cross-department work progress, and rational allocation of internal resources. These strategies provide shipping companies with several insights on how to improve their culture, management, decision-making level, and service quality, which promotes the integration of logistics.

Second, the empirical evidence revealed that EI influences OP only when the level of ISC and IQ in shipping companies that share information with their SC partners is effective. However, this result is inconsistent with the findings of previous literature that EI positively influences performance in manufacturing industry (Huo, 2012). Specifically, this result is not in line with the results of Yuen et al.'s (2019) study, which argued that EI directly affects SCP in the container-shipping industry. The ISC and IQ factor isare a core element in explaining how an organization elicits action-based capacity from EI in to enhance OP. Hence, promoting the necessary sharing of information contents and quality is required to enhance EI, and a high EI may remain unheeded without IS and IQ.

Third, regarding the relationship between II and ISC, the findings of this paper are consistent with Koçoğlu et al.'s (2011) SCI study, which identified the significant benefits of ISC when adopting SCI.

Fourth, the insignificant relationship between II and IQ may be driven by the quality of information shared among departments within a company, which may be high in certain departments but not in others. This result is similar to Li and Lin's (2006) findings, which empirically rejected the essential role played by II in directly enhancing IQ. However, even though II does not directly affect IQ, it indirectly affects IQ by mediating the relationship between EI and IQ. For this reason, to improve IQ, an appropriate strategy would be to promote EI.

Fifth, in terms of the relationship between EI and ISC, relevant plans for EI are needed to achieve better ISC, which will ultimately affect OP. This result is similar to the results of previous research (Asamoah, Andoh-Baidoo and Agyei-Owusu, 2016; Cousins and Menguc, 2006), which advocates the role of EI in enhancing ISC.

Sixth, this study's empirical results suggest that IQ is improves with better EI. This result is in line with the findings of earlier research (Chavez et al., 2015) and confirms that integration with SC partners will lead to enhanced IQ. Regarding the related practices to promote EI, Koçoğlu et al. (2011) proposed some mechanisms to induce higher levels of integration, such as collaborations between SC partners and arranging external meetings. These strategies provide companies with some insights on how to maximize flexibility in container-shipping operations and how to develop a seamless integration service in SCs.

Seventh, this study indicated that ISC has a positive effect on OP. This finding is consistent with Wu, Chuang and Hsu (2014) findings, which state that IS has a positive impact on SCP. This means that firms that share information usually endeavor to collect information related to the market environment and reflect this information in their decision-making. IS enables firms to react flexibly to their customers' needs thus leading to enhanced OP in the future. These results were also confirmed in the fashion industry by Chen et al. (2019), who indicated that SC IS can improve OP.

Eighth, IQ was shown to have a positive effect on OP, and this result is consistent with the findings of earlier studies (Li, Ye and Sheu, 2014; Zhou and Benton, 2007). It is clear that increasingly high levels of IQ along container-shipping lines will enhance OP. This finding supports the view of Li, Ye and Sheu (2014), who presented evidence regarding the direct effect of IQ on OP through social capital theory. The importance of IQ, in promoting performance in terms of OP were emphasized in previous research (Zhou and Benton, 2007). This explains why firms that share high-quality information more easily understand customer preferences and adapt their service attributes to respond to quick changes in the market environment and customer needs.

Lastly, the direct effect of II on EI was also observed in this study, in line with the findings of Yuen et al. (2019) and Yang, Yeo Gi-Tae and Vinh (2015). This suggests that, to become externally integrated, companies must first perform II. This finding supports the views of Yuen and Thai (2017b), who showed presented evidence of the direct effect of II on EI in both the manufacturing and service industries. Thus, the results of this study do not mean that II does not affect IQ at all because it indirectly affects IQ through EI suggesting that shipping companies should exchange high-quality information to improve OP. For this reason, it is not surprising that accentuating the strengthening II improves EI. This study also demonstrates that EI, IQ and ISC play partial mediating roles in the relationship between II and OP, but IQ and ISC fully mediates only in the relationship between EI and OP.

5. Conclusion

5.1. Summary

This study sought is to examine the effect of SCI on IS and OP in the container-shipping industry. Based on prior research, the research model was developed and path analysis was conducted to test the hypotheses using SEM. The core assertions was that the impact of SCI on OP is mediated by IS. EI and IQ, and ISC partially mediated the link between II and OP. However, EI was found to fully mediate the relationship between ISC and IQ and OP.

Moreover, both II and EI had a positive impact on ISC. Regarding IQ, only EI had a positive effect on IQ, while II did not have any significant impact. Although II had no significant impact on IQ, it indirectly affects IQ by mediating the relationship between EI and IQ. Lastly, both IQ and ISC had a positive impact on OP.

An online survey of employees working in liner-shipping companies and freight forwarders in Korea was conducted and yielded 149 valid responses. The results suggest that IS mediates the relationship between SCI and OP. The effect of EI on OP is fully mediated by IQ and ISC. Moreover, EI, IQ and ISC act as partial mediators in the relationship between II and OP. The total effects analysis revealed that II has the largest impact on OP, followed by EI, IQ, and ISC. This study expands SCI contexts by adopting social capital theory, wherein ISC and IQ respectively act as bridges between EI and OP. The missing link was presented in the EI of the SC of the container- shipping industry's SC. This has crucial implications for container-shipping companies in terms of improving their performance.

5.2. Implications

This study has significant academic and managerial implications. Regarding the academic implications, this study is one of the first studies to determine that IQ has a positive effect on OP in the container-shipping industry, and this result shows that an integrated SC and high IQ will have a positive effect on OP. In particular, since this result shows that IQ is more important than ISC, this study is very meaningful. Therefore, this study contributes to enhancing recent literature regarding the impact of SCI and IS on OP and provides a better understanding of how to improve the performance of container-shipping companies.

Furthermore, this paper proposed a theoretical framework of social capital theory in the container-shipping industry to investigate the relationship between SCI and IS. Several studies have explored the influence of IS on SCI and performance. However, most of these studies utilized a triadic level, with only a few studies having analyzed the effect of SCI on IS. Moreover, the effect of IS on OP in the container-shipping industry has also been rarely observed. This study deals addresses a gap in literature by attempting to analyzing the effect of SCI on IS and OP.

Last but not least, this study expands upon SCI contexts, whereby ISC and IQ acts as bridges between EI and OP. In other words, EI has no direct impact on OP, indicating that it has a positive indirect influence through ISC, and IQ. Therefore, the appropriate content and quality of information are key points to ensure the better performance of EI in the container-shipping context.

This study presents crucial managerial implications for liner-shipping companies and freight forwarders in Korea. The findings imply that the EI aspect of SCI in the container-shipping industry is a missing link. In the case of II, its effect on OP was partially mediated by EI, and IQ and ISC. However, EI was found have a full mediation effect on the relationship between II and OP. This means that EI has no direct influence on OP and functions as an antecedent of IQ and IS in the container-shipping SC. Additionally, the total effect of II on OP was greater than that of EI, which has crucial managerial implications as it means that container-shipping companies should diversify their SCI strategies to improve their OP. When integrating externally, ISC and IQ must accompany each other to improve OP. However, since II has a stronger total effect on OP, an approach with greater weight on II should be selected. In any case, managers should develop their existing II capabilities while developing their EI capabilities.

Moreover, IQ is important for enhancing the OP of Korean container-shipping companies. Although previous research has mainly analyzed ISC, the results of this study show that IQ is more important than ISC. Therefore, efforts to improve and manage IQ by integrating with shippers, shipping lines, freight forwarders, and terminal operators is important. Additionally, strong IT infrastructure activated through SCI improves IQ, allowing convenient and low-cost information exchange with lower uncertainty (Li et al., 2009).

Another noteworthy managerial contribution of this study is that it is also important to increase ISC since it also has a significant impact on OP. Therefore, efforts should be made to improve the low values of the variables' statistics in the measurement model. The average and standard deviation values of the variables indicated that the average of the IS factors was low in the IS (IS2) and marketing strategies (IS5) segment. Hence, it is also necessary to promote and improve information-sharing performance metrics and marketing-strategy information in the container-shipping industry.

5.3. Limitations and Directions for Future Research

Although this study offers both academic and practical contributions, it has some limitations. First, in this study, data collection was limited to liner-shipping companies and freight forwarders operating in Korea. Moreover, different results may be obtained from other industries as the current study's results are limited to container-shipping industries in Korea. Thus, the research can be expanded via cross-validation with other industrial groups or by conducting a comparison with other countries.

Second, this study only analyzed the impact of the various factors on OP; however, the relational performance and other elements beyond economic performance such as innovation performance can also be reflected in future research.

Lastly, as mentioned earlier, IS mediates the impact of SCI on OP. However, only a few studies have suggested the factors and solutions that hinder SCI's impact on performance. Therefore, further research on this matter is required.

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