Supply chain integration, capability and performance – a business-to-business network cooperation

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Abstract

Purpose – Supply chain integration (SCI) is a critical issue in the study of supply chain management in terms of working with partners on business networks to complete tasks, enhance capability and increase performance in a collaborative supply chain process. Thus, this study aims to investigate the influence of SCI and supply chain capability (SCC) on supply chain performance (SCP) which has a positive effect according to the degree of integration (DI) in a supply chain management process. Furthermore, the DI has a direct or indirect impact on how SCI affects SCP.

Design/methodology/approach – Through a questionnaire-survey, 454 valid responses were collected. This study investigates the relationships between SCI, SCC, SCP and the DI in the Taiwan elevator by using a structured equations model. The DI is considered as a variable for the effect of a moderated mediation in the research model.

Findings – It was found that SCI, directly and indirectly, affected the SCP in a positive way. In addition, the research model is a partial mediation model and that SCC plays a mediator role and DI also existing a moderated mediating effect in the research model. The indirect effect of SCI on SCP through SCC is stronger at higher levels of DI than at lower levels of DI.

Originality/value – This is the first study that suggests and empirically tests the moderated mediating impacts of the integration degree on the relationships between SCI, capability and performance with suppliers of the elevator manufacturing supply chain as the business-to-business network cooperation example in Taiwan.

Keywords Business strategy, Supply chain management, Operations management, Supply chain capability, Supply chain performance, Degree of integration, Business network cooperation, Moderated mediation model

Paper type Research paper

1. Introduction

Integration can be defined as working with others to complete tasks and to achieve shared goals. As such, it is a recursive business process, in which two or more people or organizations work together. Thus, this process represents more than simply the intersection of common goals, as seen in co-operative ventures, but a deep, collective, determination to achieve a common objective (Martinelli and Tunisini, 2019). In particular, in supply chain integration (SCI), firms that work collaboratively can obtain greater resources, recognition and rewards when facing competition for finite resources. SCI is one of the critical issues in the study of supply chain management (Tarifa-Fernandez and Burgos-Jiménez, 2017). In the past several decades, there has been a need for firms to look inside their industry for opportunities to collaborate with partners to ensure that the supply chain is efficient and responsive to dynamic market needs. Firms in a supply chain have strived to achieve greater SCI to leverage the business network resources and knowledge of their suppliers and customers and thereby achieve a stronger competitive position (Rampersad *et al.*, 2019). Flynn *et al.* (2010) defined SCI as, "the degree of integration (DI) to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organization processes." They acknowledged that SCI can be categorized into multiple dimensions considering the width of the integration, most prevalently into internal, customer and supplier integration, the latter two together forming the concept of external SCI.

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SCI plays a pivotal role in improving supply chain capability (SCC) (Yang, 2016) and supply chain performance (SCP) (Bruque-Cámara *et al.*, 2016). SCI requires a collaborative effort among suppliers, cross-functional departments and customers that are linked and coordinated by the flow of business processes and information (Murphy *et al.*, 2019). The SCC that enables firms to cope with uncertainty and gain a competitive advantage through supply chain responsiveness is imperative (Golgeci and Gligor, 2017). In fact, SCC encompasses all facets of a firm's activities directed toward producing a product or rendering a service. SCP is a "firm-specific sets of skills, processes, resilience and routines, developed within the operations management system that is regularly used in solving its problems through configuring its operational resources" (Kou *et al.*, 2018). These operational resources involve the ability to coordinate all related parties to work together as a whole to exchange information and develop a shared definition of the supply chain solutions needed for generating performance (Chang *et al.*, 2016). Both SCC and SCP are supply chain strategies because they can help firms to repeatedly conduct productive tasks that relate to the transformation of inputs into outputs. In addition, SCP refers to the ability to integrate, build, structure and reconfigure internal and external competencies to meet the requirements of changing environments and generate multiple sustained competitive capabilities simultaneously in dynamic, unstable or volatile environments (Mandal, 2018).

This study aims to investigate how the DI affects SCI, SCC and SCP in the industry, based on the case of the Taiwanese elevator industry. Moreover, the relationships among these four variables are another focus of our study. The present study assumes that the relationships among these four variables are very important aspects of the supply chain issue. SCI allows the industry to obtain new resources from outside the industry. The resources acquired are then integrated into the supply chain including, upper stream, middle stream and lower stream as their different positions (Nguyen *et al.*, 2019). An outside resource serves as a valuable input into internal resources and transfers to different tiers of the supply chain through the DI. The supply chain thereby integrates the outside resource with the existing resources to enhance internal capability. Through acquiring new resources through integration, the partnerships of supply chains can transfer and share resources and then offer feedback to enhance SCI (Kirchoff *et al.*, 2016). In this way, the cycle goes on continuously. In addition, this circulation of resources through SCI contributes to internal capability and improves SCP.

In recent years, along with changes of the patterns of Taiwanese architecture, new developments and demands have appeared in the elevator industry. As in other industries, customized production and services of elevators have emerged. Owing to the innovative development of elevator manufacturing technology, Taiwanese elevator manufacturers have gradually overcome technical suppression from foreign manufacturers and developed their own brands. In the elevator supply chain, the integration of the supply chain is very tight-knit and the interaction and relevance of each link in the chain are very important. Through the integration and improvement of supply chain ability, overall performance can be promoted so that elevator parts can be rapidly produced and delivered while still meeting the demands of production quality and specifications. SCI can also improve suppliers' production delivery process, quality specifications and coordination of operational processes to improve the speed and operational flexibility of the entire supply chain. Efficient elevator SCI drives the supply chain's ability to produce parts and components needed to manufacture products while pursuing maximum value to improve the performance of the supply chain. In the past decade, the Taiwanese elevator market has maintained stable development; still, in face of the strong competition and the dynamic demands of clients, the traditional production method has been unable to rapidly respond to the market demand. For example, in 2019, Taiwan elevator production reached 9,810 units and the annual production value was NT$9,171,558,000. The production volume of elevators has grown steadily and the total production value and relative manufacturing costs have also increased. SCI and collaboration have become important business strategies of enterprises. The annual report of the Taiwan elevator association (Taiwan elevator annual report, 2020) found highly integrated relationships in the supply chain of the elevator industry. The technology source of the upper reaches of Taiwan's elevator industry came from Japan in the early days. Afterward, after technology transfer and equity mergers and acquisitions, three major Taiwanese manufacturers are now responsible for the operations of the supply chain. In the process of competition and cooperation, the coordination and cooperation of the supply chain have become an important opportunity for the survival and development of Taiwan's elevator industry in both domestic and mainland China markets. Thus, integration and the DI on the supply chain become a critical issue not only on academic and but also on practical research. The suppliers of the supply chain can effectively promote the overall performance of the supply chain through the enhancement of integration and capabilities. Therefore, supply chain management is relevant to the survival of the Taiwan elevator industry.

This study aims at investigating how DI moderates SCC and SCP on the relationships between SCI, SCC and SCP in the Taiwan elevator industry. However, the relationships among these four variables are another focus of our study. The present study considers that the relationships among these four variables are very critical to the issue of supply chain and business-to-business network cooperation. SCI allows supply chain members to obtain high quality of collaboration as a value input to participate in their roles in the supply chain (Kumar, 2021). The SCI acquired belongs to collaboration and cooperation are featured as a valued supply chain resource (Irfan and Wang, 2019; Dobrucalı, 2020; Ataseven *et al.*, 2020). This study proposes a conceptual model that valuable resource of SSI (resource input) is transferred into SCC and build SCP by integrated capability and spread to other units of the business-to-business network cooperation through DI as a mediation role (resource output) (Mandal, 2017; Wang *et al.*, 2021). The supply chain management thereby focuses on the specific role of DI with the influence on SCC and SCP (Rajaguru and Matanda, 2019; Irfan and Wang, 2019; Han and Huo, 2020; Ganbold *et al.*, 2021). Through DI, the business-to-business network cooperation can moderate the SCC into their SCP as a moderated mediation role (Tobias and Swink, 2012; Ojha *et al.*, 2018; Song and Morgan, 2019; Zimmermann *et al.*, 2020; Afraza *et al.*, 2021). The supply chain may continue to enlarge its resource integration and then possess

a high degree of SCC, which enhances its SCP (Liu *et al.*, 2018; Liu *et al.*, 2021). In this way, the cycle goes on continuously on a supply chain. Figure 1 shows a conceptual framework in terms of the theoretical model development of this study.

However, could the proposed conceptual model have a positive effect on a supply chain? Furthermore, does the DI have a direct or indirect impact on how SCI through SCC affects SCP in the Taiwan elevator industry? This study builds and empirically tests a comprehensive model to describe how SCI influences SCC and how SCI influences SCP practices in the Taiwan elevator industry supply chain. By extending the SCI concept and linking it with the proposed conceptual framework, this study contributes to the SCI, SCC, SCP and DI literature. Moreover, the proposed theoretical model practices and tests the abovementioned relationships.

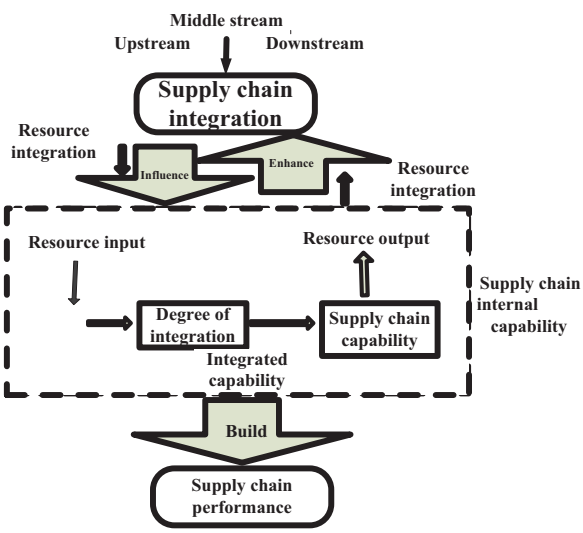
2. Theoretical model development

2.1 Relationship between supply chain integration and supply chain capability

In an empirical study of Korean and Japanese manufacturing industries, Kim (2006) discovered that organizations' supply chain capabilities of service and selling can be effectively improved by enhancing the DI of cross-functionalities, customers and suppliers. Swink *et al.* (2007) conducted a study of South American manufacturing industries and found that after the integration of customers and suppliers, significant positive impacts did occur in the supply chain capabilities of transportation ability, process flexibility, new product flexibility and others. Wu *et al.* (2010) pointed out that when the suppliers of a supply chain integrate the supply chain, the operation process of research & development and decision-making becomes closer; also, the suppliers mutually support each other to solve problems such as those related to manufacturing technology. This allows the entire cooperative network to become closer and enhances supply chain capabilities. Although research about SCI and SCC is relatively a few studies, based on the above statements discussion, we conclude that SCI does positively affect SCC. Rajaguru and Matanda (2019) investigated the mediating role of inter-organizational information system (IOIS) integration on the relationships between inter-organizational capability and supply chain capabilities. The results indicate that the inter-organizational capability of technical, strategic and cultural inter-organizational dimensions facilitate IOIS integration and supply chain capabilities. Yang (2016) examined the relationships among SCI, supply chain service capabilities, market performance (MP) and financial performance (FP) in the container shipping context. The author confirmed that SCI has a positive impact on supply chain service capabilities, which, in turn, helps to enhance MP and FP. Rajaguru and Matanda (2019) indicated that technical, operational and cultural compatibility facilitates supply chain process integration. In support of dynamic capabilities theory, the study reveals the importance of integrating resources among supply chain partners to achieve supply chain capabilities, operational and competitive performance in food and hardware retailing businesses in Australia. On the other hand, Irfan and Wang (2019) revealed that SCI (i.e. internal integration [II] and external integration [EI]) significantly mediates the effect of data-driven capabilities (i.e. flexible information technology resources and data assimilation) on a firm's competitive performance. In addition to the direct effects, II also has an indirect effect on competitive performance through EI in the food and beverages industry in Pakistan. After enumerating the research results of different industries, this research suggests that in the elevator industry, SCI has a positive relationship with SCC. Thus, this study proposes the following hypothesis:

H1. SCI is positively related to SCC.

Figure 1 A supply chain collaborative business process management framework



2.2 Relationship between supply chain integration and supply chain performance

Gimenez and Ventura (2005) pointed out that EI also has a direct and positive impact on performance. Although the DI between supply chain partners has several benefits from, the results of empirical studies of SCI and performance are still inconsistent. For instance, some studies found a positive relationship between the degree of SCI and performance (Lummus *et al.*, 2008) while the empirical results of other studies found that there was an insignificant relationship between the two (Flynn *et al.*, 2010); some studies have even pointed to a negative relationship between the level of SCI and performance (Swink *et al.*, 2007). Yu *et al.* (2013) further indicated that II significantly influences EI and has a significant influence on SCP. Zhao *et al.* (2015) pointed out that the increase and expansion of SCI can trigger the increase of overall SCP. Research has found that II has a direct and positive impact on the organization's performance. Bruque-Cámara *et al.* (2016) analyzed the effects exerted by a specific type of cloud technology on a particular type of SCI (integration of informational and physical flows). They also analyzed the combined effect of community cloud computing and physical-informational SCI on firms' operational results. The authors used factorial analyzes and structural equation modeling to test the proposed hypotheses. Three hypotheses were confirmed, indicating that the community cloud exerts a positive and significant effect both on the informational-physical integration of the supply chain and on operational

performance. Wong *et al.* (2017) analyzed the role of national culture in affecting SCI. They examined how differences in national culture influence SCI operational outcomes. The research results indicated that collaborative behavior-oriented dimensions of national culture, including future orientation, institutional collectivism, humane orientation and in-group collectivism, moderate the extent to which SCI improves operational performance. Specifically, the relationship between II and quality outcomes is moderated by institutional collectivism, humane orientation and future orientation. The relationship between II and cost is moderated by in-group collectivism while customer integration and delivery performance relationship are moderated by institutional collectivism. Delic *et al.* (2019) indicated that additive manufacturing adoption positively influences SCP and as a consequence, firm performance. In addition, supporting the resource-based view (RBV) perspective, the results show a positive indirect effect of SCI on the supply chain and firm performance improvements, enabled by the additive manufacturing adoption in Croatia. Ataseven *et al.* (2020) shown that for not-for-profit food banks, EI should precede II and that demand integration has a stronger influence on SCP than supply integration in the context of food banking in the USA. SCI and SCP have found positive correlations in different industries in the past literature. However, for the elevator industry, no empirical results have found such a relationship so far. Based on the above discussion, we conclude that SCI is closely related to SCP. Thus, the following hypothesis is formulated:

H2. SCI is positively related to SCP.

2.3 Relationship between supply chain capability and supply chain performance

Morash (2001) suggested that customer service capability, quality capability, information system support capability, distribution flexibility capability, production capability and transport capability can bring sustainable competitive advantage to an organization and thereby promote SCP. The RBV suggests that differences in SCP essentially depend on the heterogeneity between suppliers. Core competencies, including skills, assets and technology, support the sustained growth and differentiation of enterprises (Parry *et al.*, 2010). Swink *et al.* (2007) also indicated that enterprises upgrading transport capability and process flexibility are more likely to meet higher performance levels. To sum up research results, customer service capability, information system support capability, productivity and distribution capability significantly impact SCP. Liao and Kuo (2014) also suggested that industries improve supply skills and technology by upgrading SCC. Mandal (2017) explored the influence of a hospital's capability of sensing, learning, coordinating and integrating hospital-supplier collaboration. Second, it explored the influence of hospital-supplier collaboration on the hospital's SCP. The author also explored how the technology orientation of the medical chain units influences the above linkages. Also, the author found positive influences of virulence factors, learning and integration on hospital-supplier collaboration and a positive impact of hospital-supplier collaboration on hospital SCP. Under the financial supply chain (FSC) environments, Wang *et al.* (2021) found that supply chain business network capability raised corporate FP in China. The joint investment activities among supply chain partners and financial service providers help managers understand the advanced financing solutions generated by internal and external network organizations, as well as be aware of network capabilities' impact on corporate financial performance in FSCs. Based on the above findings, we conclude that SCC positively affects SCP. Thus, the following hypothesis is formulated:

H3. SCC is positively related to SCP.

2.4 Relationships among supply chain integration, supply chain capability and supply chain performance

Kim *et al.* (2010) pointed out that if an organization is embedded in a highly integrated supply chain, the partners can easily share special knowledge and technology while an individual supplier only needs to develop the specific capability to acquire competitive advantage through sharing. Using SCC as a mediator, Swink *et al.* (2007) conducted research on customer integration, supplier integration and SCP, to discover that customer integration and supplier integration indirectly affect SCP through SCC. Mandal *et al.* (2017) investigated the inter-relationship among dominant supply chain capabilities of collaboration, flexibility, velocity and visibility and how this inter-relationship influences supply chain resilience (SCRES) and SCP. Further, the above study aimed to explore the relationship between integrated logistics capabilities and supply chain capabilities. Integrated logistics capabilities were found to positively influence supply chain collaboration and supply chain visibility. Collaboration, flexibility, visibility and velocity all positively influence SCRES. Moreover, each of these supply chain capabilities positively influences each other to a greater extent. Additionally, SCRES was found to have a positive influence on SCP. In the Chinese context, Liu *et al.* (2018) found that both internal and external SCI capabilities are significantly related to the successful adoption of a green design strategy. However, the relationships are not significant in the Western context. Green design is found to positively impact environmental performance in both contexts; however, no significant relationship is revealed between green design and economic performance in either context. Finally, environmental performance on their study was found to have a significant and positive impact on economic performance in both contexts in China auto industry. On the other hand, Liu *et al.* (2021) found that EI fully mediates the effect of novelty-centered business model design (BMD) on operational performance and efficiency-centered BMD directly improves operational performance in 131 Chinese manufacturing firms. Based on the above findings, we conclude that SCI affects SCP through SCC and propose the following hypothesis:

H4. The relationship between SCI and SCP is mediated by SCC.

2.5 Relationships among supply chain integration, supply chain capability, supply chain performance and degree of integration

Lummus *et al.* (2008) revealed that a higher level of SCI improves SCP even more. In pursuit of overall SCP, partners in

a supply chain should continue to integrate so that the relations between partners become closer and thereby improve overall performance (Hertz, 2001). From this point of view, the DI in SCC determines the enhancement of SCP. Kim (2006) claimed that organizations that strengthen internal cross-function and customer and supplier integration effectively enhance service capability, distribution capability, transportation capability, manufacturing flexibility and new product flexibility. This suggests that a higher degree of SCI will lead to better SCC. Sorce *et al.* (2005) revealed that cooperation with suppliers improves SCP. Tobias and Swink (2012) discovered that the DI has a positive influence on SCP. Fazio *et al.* (2017) proposed a moderated mediation model of affective commitment in the relationship between social support and turnover intention. Their findings emphasized the independent impact of perceived social support above and beyond the effect mediated by affective commitment, thus adding evidence to the debate on the extent of the mediating effect of affective commitment. Moderated mediation model that investigates supply chain management is a few. Mostly, innovation, uncertainty, environmental dynamism and strategy are considered as a moderator which influences on mediating the relationship between SCC and performance (Ojha *et al.*, 2018; Song and Morgan, 2019; Zimmermann *et al.*, 2020; Afraza *et al.*, 2021). However, this study is the first study to propose that the influence of SCC on SCP could produce different results according to the DI of the supply chain. Furthermore, the DI impacts the indirect effect of SCI on SCP. Thus, we propose the following hypothesis:

H5. The indirect effect of SCI on SCP through SCC is stronger under higher levels of DI than under lower levels of DI.

There are many complex relationships between SCI, SCC, SCP and DI. The theoretical model in Figure 2 indicates the main influence. In addition, we have identified some other factors affecting SCI, SCC, SCP and DI.

3. Research design

3.1 Sample structure

The sampling objects of this study include the workers responsible for the production and logistics of the suppliers of one well-known domestic elevator manufacturer. The formal questionnaire was administered in May 2018. A total of 500 questionnaires were sent. Of which, 454 valid responses were received, for an effective response rate of 90.8%. Companies with annual revenue above 50 million accounted for 58.15%; companies with 11–50 employees accounted for 39.87%, which is the largest group. Of these 454 respondents, 62.78% were male and 28.19% were officers/engineers; employees with 6–10 years of seniority were the largest group, accounting for 24.89%.

3.2 Operational definitions and questionnaire design

This study defines SCI as the performance of supply chain partners in terms of the trust, interaction, mutual responsibility, risk and benefits, autonomous problem-solving capability and aggressive and voluntary handling of new challenges Appendix 1 (Lockstrom *et al.*, 2010). We point out 8 items relating to SCI. SCC was defined, with reference to the research of Appendix 2 Morash *et al.* (1996) and Lynch *et al.* (2000), as the capability to provide customers with products or services with maximum added value and sustained improvement of customer satisfaction. There are 7 items relating to SCC. For the evaluation of SCP, this study referred to the views from Appendix 3 Venkatraman (1986) and Tracey *et al.* (2005), drawing on the perspectives of finance, market and customer value. There are 8 items relating to SCP. Based on Appendix 4 Kim (2006), this study defined the DI as the depth of integration between the company and supplier. There are 6 items relating to the DI (Kim, 2006). For the needs of this study, a pre-test questionnaire was conducted to check where the questionnaire could be modified. We randomly selected 35 elevator supply chain firms and sent out a total of 29 questionnaires, from which a total of 35 valid responses were received. After checking the reliability and validity of the received questionnaires, the results showed the questionnaire did not need to be modified.

4. Analysis and results

4.1 Preliminary analyzes

In the reliability analysis, the Cronbach's are all between 0.85∼0.89. The results are shown in Table 1. In the validity analysis, the *t*-value of all items is between 8.13∼33.96 indicating good convergent validity. Table 1 provides means, standard deviations and inter-correlations for all variables. The SCI was

Figure 2 Theoretical model

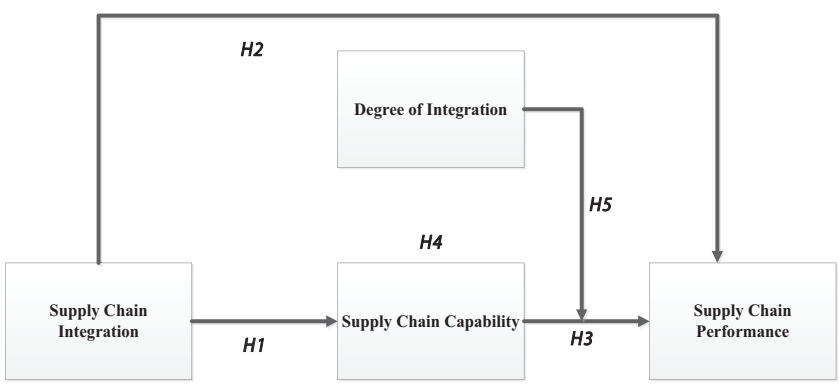


Table 1 Reliability

Variables	Items	Cronbach's α
Supply chain integration	8	0.88
Supply chain capability	7	0.86
Supply chain performance	8	0.89
Degree of integration	6	0.87

Table 3 Means, standard deviations and correlations

Variable	Mean	SD	1	2	3
1. Supply chain integration	5.94	0.71	1		
2. Supply chain capability	6.17	0.57	0.61**	1	
3. Supply chain performance	5.58	0.81	0.43**	0.50**	1

Notes: $N = 454$; $^{**}p < 0.01$

positively related to SCC ($r = 0.61$, $p < 0.01$) and to SCP ($r = 0.43$, $p < 0.01$). In addition, SCC had significant relationships with SCP ($r = 0.50$, $p < 0.01$). The aforementioned correlated coefficients were related only to the relationships between some of the variables, although they provided a crucial basis for our further analyzes (Effelsberg *et al.*, 2014).

4.2 Measurement model test

Confirmatory factor analysis (CFA) primarily explores the fit between a variable's factor and its measurement item in this questionnaire. The Cronbach's α of all variables illustrates that the reliability of the measurement model is good (Table 1). On the other hand, the model fit also is good as follows: goodness of fit index and non-normed fit index are greater than 0.90, comparative fit index is greater than 0.90, standardized root mean square residual ranges from 0.02 to 0.03 and root means square error of approximation (RMSEA) ranges from 0.05 to 0.07 (Table 2). Means, standard deviations and correlations are illustrated in Table 3.

4.3 Structure model test

The structure model test results indicate that the correlations between variables are all significant. This study tests five hypotheses with the structural equation model. This model provided an adequate fit to the data Chi-square (χ^2) = 333.21, $p <$ 0.00; RMSEA = 0.079. Figure 2 shows the results of the structural equation model of the variables in this study. It indicates that the *T*-values of these paths, including SCI – SCC, SCI – SCP and SCC – SCP, are significant; the parameter estimates are 0.71, 0.18 and 0.3, respectively.

4.4 Common method variance test

While using Harman's one-factor test, we assumed if a single factor extracted after the factor analysis or the main variation is more than 50% while a comprehensive factor is used to explain independent variables and dependent variables, then a serious problem with common method variance is present (Mattila and Enz, 2002). According to the test results of the present study, a total of four factors were extracted. Among them, the variance explained by the first factor is 39.80%, which is less than 50%, indicating the present study does not have a serious problem of common method variance.

4.5 Hypotheses testing

This study estimated the γ and β of the theoretical model by maximum likelihood estimation (MLE) to test whether each hypothetical path has achieved a significant level. Basically, an optimal sample size for MLE to estimate a structural model range from at least 100 to 150. Figure 3 shows the structural model with the standardized coefficients for the research sample. This study examined whether SCI has a positive effect on SCC (*H1*), if SCI relation is positively associated with SCP (*H2*) and if SCC is positively associated with SCP (*H3*). Results indicate that the relation between SCI and SCC is positively associated ($\gamma_{11} = 0.71$), thereby supporting *H1*. The relation between SCI and SCP is significant positively ($\gamma_{21} = 0.18$), supporting *H2*. Due to the significant positive relation between SCC and SCP ($\beta_{21} = 0.36$), *H3* was also supported. According to the LISREL8.8 output of direct and indirect effects (Table 4), the results of *H4* can be seen as follows: the direct effect of SCI on SCP is 0.18 and its indirect effect is 0.25, which indicates our research model is a partial mediation model and that SCC plays a mediator role. Thus, *H4* was supported.

To test whether there is a moderated mediation effect in our research model (*H5*), this study first examined moderating effects of the DI on the relationship between SCC and SCP. We then further examined whether these effects moderated the indirect effect of SCI on SCP through SCC. The results in Table 5 show that the cross-product term of SCC × DI in the outcome variable model (SCP) is significant ($B = 0.31$, $p < 0.01$). The slope of the relationship between SCC and SCP is stronger for supply chain partners with a higher DI ($B = 0.58$, $t = 7.31$, $p < 0.01$). We further validated the conditional indirect effect of SCI on SCP

Table 2 Fit statistics of the CFA model

	Supply chain integration	Supply chain capability	Supply chain performance	Degree of integration
GFI	0.99	0.99	0.99	0.98
AGFI	0.97	0.96	0.96	0.95
SRMR	0.03	0.02	0.03	0.03
RMSEA	0.05	0.06	0.07	0.07
NNFI	0.98	0.98	0.99	0.97
CFI	0.99	0.99	0.99	0.99
Normed χ^2	2.34	2.68	3.15	3.35

Notes: AGFI = Adjusted goodness of fit index; GFI = Goodness of fit index; SRMR = Standardized root mean square residual; NNFI = Non-normed fit index; CFI = Comparative fit index

Figure 3 Path diagram of structural equation model

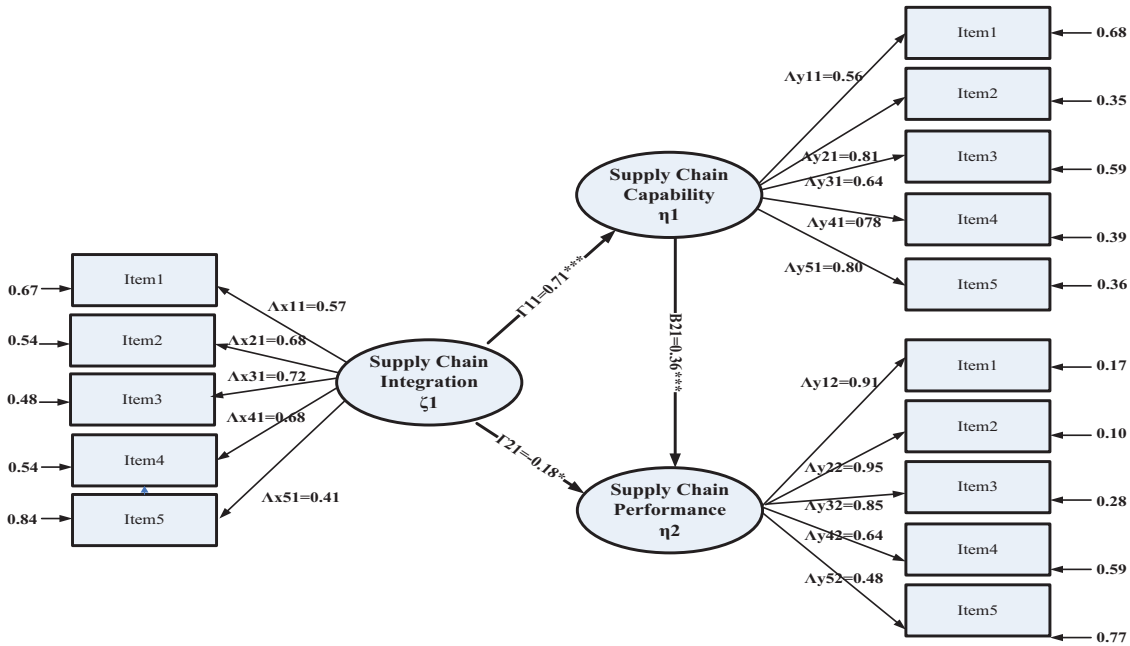


Table 4 Total and indirect statistical effects

	Mediator supply chain capability			Outcome supply chain performance		
	E	*t*	*p*	*E*	*t*	*p*
Total effect				0.43	8.27	***
Direct effects						
Supply chain integration	0.71	9.96	***	0.18	2.25	*
Supply chain capability				0.36	4.36	***
Indirect effect				0.25	4.45	***

Notes: *N = 454; E: parameter estimate;* $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

Table 5 Regression results for moderation and moderated mediation model**

	Supply chain performance		
	B		*p*
Direct statistical effect			
Supply chain integration	0.03		
Supply chain capability	0.37		**
Degree of integration	0.65		**
Supply chain capability × Degree of integration	0.31		**
R^2	0.43		
Conditional indirect stat. effect, bootstrap results	M	SE	95%CI
Degree of integration M −1SD	0.09	0.05	−0.01, 0.19
Degree of integration M	0.18	0.05	0.09, 0.30
Degree of integration M +1SD	0.28	0.06	0.16, 0.41

Notes: M average bootstrap estimate; values for quantitative moderators are the mean and plus/minus one SD; Bootstrap sample size = 5,000; 95% CI confidence interval, bias-corrected and accelerated, first (second) value representing lower (upper) limit; N = 454

(through SCC) at two values of the DI as follows: one standard deviation above the mean (+1 *SD*) and one standard deviation below the mean (−1 *SD*). We generated bootstrap-based confidence intervals for the conditional indirect effects at three different moderator values. According to Table 5, the indirect effect through SCC increased when conditional indirect effects were different from zero. These effects were based on the moderator values of M +1SD (average bootstrap estimate = 0.28, 95% CI [0.16, 0.41]). The conditional indirect effect became stronger to the level that the DI increased as the moderator. Furthermore, according to Table 6 and Figure 4, the moderated mediation model was proven, which supports *H5*.

5. Managerial implications

5.1 Theoretical implications

The study results support the positive impact of SCI on SCC and the analytical results coincide with Kim (2006). The suppliers of the Taiwanese elevator manufacturing supply chain (i.e. material supplier, component supplier and outsourcing supplier) should upgrade of integration between supply chain partners in terms of business process management. SCI will attain higher efficiency in the support and cooperation of production manufacturing. Meanwhile, development and design changes in new products and the innovative design of elevator components will lead to full cooperation and support, thus facilitating the upgrade of the overall capability in the supply chain and thereby improving the production quality and efficiency. Wu *et al.* (2010) revealed that the mutual support between suppliers to solve problems and cooperate in processing technologies in times of SCI maximizes the integration effect while allowing supply chain partners to improve supply chain-related business process capabilities.

The study findings suggest that SCI has a positive impact on SCP, indicating the better the SCI, the more optimal SCP. Due to changes of the environment and expansion of elevator productivity, integration of the supply chain is important to reach maximum production performance. The relation of the supply chain will need to undergo changes to enhance information sharing and production technology instructions, thereby improving the overall SCP through effective business process integration (Roh *et al.*, 2016). Zhao (2015) also pointed out the internal support of enterprises drives the growth in SCI and FP while FP, operational performance and organizational operation performance in SCP lead to maximization due to the integration between supply chain partners.

Study findings suggest that SCI has a positive impact on SCP, indicating the better the SCI, the optimal SCP will be created. Chen and Paulraj (2007) stated that the organization strengthening the relation with supply chain partners will enhance the level of information sharing between supply chain partners and will contribute to the interdepartmental integration in enterprises and the integration of supply chain partners. Due to the change of environment and expansion of elevator productivity, it is highly important for the integration of the supply chain to reached maximum production performance. The relation of the supply chain will need to undergo changes to enhance information sharing and instructions of production technology, thereby improving the overall SCP through effective integration (Roh *et al.*, 2016). Zhao (2015) also pointed out the internal support of enterprises will drive the growth in SCI and FP while the FP, operational performance and organizational operation performance in SCP will attain maximization due to the integration between supply chain partners.

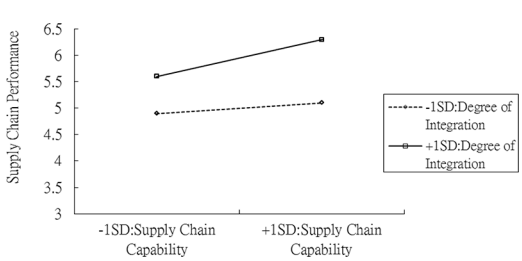
Research results reveal that SCC has a positive relation with SCP, suggesting higher SCC in the elevator manufacturing supply chain will lead to better SCP. This result is consistent with the conclusion of Parry *et al.* (2010) that the differentiation of SCP is essentially based on the core capability of suppliers. Liao and Kuo (2014) suggested that the upgrade of industries through SCC will improve suppliers' capability in producing high-quality products and on-time delivery. For the elevator industry, the production technology and quality control of suppliers are very important. The strengthening of suppliers' SCC is one of the foremost steps in upgrading the overall SCP. The strengthening of various core capabilities of suppliers in production, technology, quality and delivery will drive the SCC while upgrading SCP.

Research findings revealed that SCC plays a mediator role in the relation between SCI and SCP (Morash, 2001; Mandal, 2017; Wang *et al.*, 2021). This finding coincides with Morash (2001), who proposed that when SCI and SCC increase, SCC effectively meets the strategic objectives of the enterprise and improves SCP. Some other capabilities such as human resource capabilities, innovative capabilities, technological capabilities, alliance capabilities and research and development capabilities work toward managing flexibility at the strategic level in manufacturing organizations (Liu *et al.*, 2018). Thus, this study suggests that the elevator manufacturing industry focuses on SCC to improve SCP.

Table 6 Index of moderated mediation

Mediator	*Index*	*SE*	*95%CI*
Supply chain capability	0.15	0.04	0.08, 0.25

Figure 4 Moderated mediating effect of degree of integration on the relationship between supply chain capability and supply chain performance



5.2 Managerial implications

This study is the first study that adopted a DI as the moderated variable for analyzing if there is moderated mediation effect in the mediation model of SCI, SCC and SCP. The results indicate that the DI showed a positive moderated mediation effect in SCC and SCP. Apparently, the material suppliers,

component suppliers and outsourced suppliers of the elevator industry can enhance the DI with elevator manufacturers to improve overall SCP.

The supply chain of elevator manufacturing is horizontally integrated, where the supply chain suppliers upgrade SCI through close information, technology and resource sharing in a business process. The elevator manufacturing companies also lead the suppliers to make progress so that the SCI will improve more while enhancing the SCC of supply chain partners. This study first analyzes the horizontal integration of the elevator industry supply chain in Taiwan. This elevator industry is currently limited to the construction industry and development is limited within this scope. Hence, it is suggested that the SCI of the elevator industry should not only remain limited to the elevator industry but also seek strategic business collaborations with other industries. Consequently, the supply chain of elevator manufacturing would shift from horizontal integration to vertical integration across industries in the business cooperation process and thereby expand the niche market for future elevator manufacturing development.

6. Conclusion

Prior studies have mostly analyzed the relationships among SCI, SCC and SCP (Swink *et al.*, 2007; Kim, 2006). This study contributes by further helping us to understand how the effect of SCI on SCP through SCC is subject to the moderation of DI of supply chain partners and thereby produces a moderated mediation effect on a business network cooperation. Among previous articles that have analyzed the relationship among SCI, SCC and SCP, few papers have studies suppliers of elevator manufacturing supply chains as the sampling objects. The results of this study verify the relations between research variables and combine theories and practice. Thus, this study is the first to suggest and empirically test the moderated mediating impacts of the integration degree on the relationship between the SCI, capability and performance as the business-to-business network cooperation example.

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Appendix 1. Items measuring SCI

Supply chain integration

1. Your company frequently exchanges information on the rise and fall of raw materials with customers.
2. Your company communicates with customers about the design content of new or customized products.
3. Your company communicates with customers about the processing procedures of new or customized products.
4. Your company voluntarily exchanges production information that will affect delivery to customers at all times.
5. Your company and customers have a common product development mechanism.
6. Your company and customers have a common product improvement mechanism.
7. Your company and customers have a common manufacturing process improvement mechanism.
8. The main communication tools between your company and customers include as follows: telephone, fax, text message or email.

Appendix 2. Items measuring SCC

Supply chain capability

1. Your company is equipped with the capacity to simplify the transacting administrative process with customers and remove unnecessary or redundant operation procedures.
2. Your company meets customer requirements in product quality capacity.
3. Your company has the capacity to deliver on time.
4. Your company maintains excellent relations with customers.
5. Your company solves problems for customers.
6. Your company standardizes products and service processes.
7. Your company is incapable of meeting customers' requirements in new product development in times of development collaboration.

Appendix 3. Items measuring SCP

Supply chain performance

1. The profitability of your company is positive.
2. The operational costs of your company are declining.
3. The overall competitive position of your company is upgrading.
4. The market share of your company is increasing.
5. The sales growth rate of your company is rising.
6. Customer satisfaction with your company is improving.
7. Your company has improved the control capacity to change to meet customer requirements in the process of developing new products.
8. Your company is capable of producing new products that meet the customer requirements from different industries.

Appendix 4. Items measuring the DI

Degree of integration

1. The relationships between your company and suppliers are based on mutual trust and benefits and consensus of co-existence and co-prosperity.
2. Your company and suppliers engage in high participation during the product design stage.
3. The collaboration between your company and suppliers is long-term.
4. The correspondence and communication between your company and suppliers highly rely on electronic forms.
5. Your company engages in a high level of information sharing with suppliers.
6. Suppliers can quickly satisfy the requirements of your company.

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