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## **Investigating the Impact of the Strength of Supply Chain Integration on Cost and Responsiveness**

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## **Abstract**

The purpose of this paper is to investigate strength of supply chain integration based on social exchange theory and its resultant impact on supply chain cost and responsiveness. The study surveyed Korean export firms and obtained 182 usable responses. Data were analysed using cluster analysis and analysis of variance. Findings confirm that the strength of supply chain integration provides a mechanism for measuring the width of integration for both suppliers and customers. Further, identifiable gaps in cost performance and responsiveness were found based on strength of supply chain integration. This paper contributes through the development and testing of a conceptual model based on social exchange theory and also offers managerial suggestions in the understanding of customer needs and the importance of sharing information with suppliers in achieving improved cost performance and responsiveness in the supply chain.

**Keywords:** Supply Chain Integration, Relationships, Performance, Social Exchange Theory, Korean Exporters

## **Introduction**

Despite much attention and theoretical research pertaining to supply chain management (SCM) and supply chain integration (SCI), there are still areas requiring further understanding about these linkages. The literature has been mostly concerned with classification methods of vertical and horizontal integration, or width and depth of integration, but there are few papers discussing a common viewpoint addressing both aspects. Further, there is limited insight into the types of SCI measures and how SCI is measured. These gaps offer an opportunity for additional research on SCI regarding inter-firm relationships in supply chains.

Inter-firm relationships can either be competitive or collaborative. Competition along supply chains has evolved and firms have the options to structure their supply chain relationships either through vertical i.e. forward and backward and/or horizontal integration with other supply chain members in a network style structure to achieve competitive advantage (Pellinen et al., 2016). Relationships development in supply chains can be considered as SCI. This can include high levels of integration through strong connections between participants in a supply chain network where they have commitment and a cooperative attitude in the relationship.

The purpose of this paper is to investigate strength of supply chain integration (SCI) based on social exchange theory and its resultant impact on supply chain cost and responsiveness. The

paper therefore presents a multidimensional approach for SCI extending from one dyadic dimension to integration as a form of social exchange. It focuses on present levels of SCI in firms through the development of a measurement method for SCI strength of relationships and verifying gaps in performance resulting from SCI strength. The flowchart for this study is shown in Figure 1.

**Insert Figure 1 here.**

## **Literature Review**

The purpose of the literature is to provide an overview of the current body of knowledge related to SCI and its gaps. We begin by discussing previous work on supply chain relationships firstly in isolation and then in conjunction with SCI, followed by discussions about the strength of SCI and its effect on cost and responsiveness, two key performance measures (Brewer and Speh, 2000). We then conclude this section by summarising the research gaps informing our empirical study and present our conceptual model and hypothesis development.

### ***Supply Chain Relationships***

Firms can obtain resources through markets or hierarchy. They gain resources through markets if there is no transaction cost under a stable environment. However, firms can ensure resources through hierarchy if there is a transaction cost in the market in an uncertain environment. Williamson (1996) argued that firms operate in networks in addition to market and hierarchy with performance supplied through network relationships where firms are included.

Relationships between sellers and customers as inter-corporate relationships are not treated as discrete transactions within supply chains (Daugherty, 2011). Suppliers, focal firms i.e. the firm of interest to researchers and managers, and customers all exchange information and operational cooperation make supply chain processes more efficient. Inter-corporate relationships in supply chains are divided dyadically into relationships with suppliers and customers. The perspective of Porter (1980) is focused on customers while Hingley et al (2015) highlighted the equal importance of suppliers.

Inter-corporate relationships in supply chains is in the middle between market-governed transactions and complete systems' ownership (Daugherty, 2011). Firms face different relational systems based on their respective context and is related to networks on the basis that

the strength of each network is different. Therefore, network strength can be explained as an inter-corporate relationship faced by firms. Lin and Lin (2016) investigated the effect of network relationship on SME performance and determined that two factors affected network relationships, one is network content, or the characteristics within the network, and the other is network relationship.

Supply chain relationships depend on market orientation. Sales information generated by customers, is combined with supply information and integrated with manufacturers' production information. In addition, production information is shared with suppliers. Supply chain effectiveness is achieved because supply chain members share market information such as customer needs and competition levels.

After the work of Stevens (1989), research on SCI was performed from various viewpoints that can be classified in two distinct spectra. The first, from a structural viewpoint, consists of vertical and horizontal integration (e.g. Mason et al., 2007 and Hingley et al., 2015). The second, from a behavioural viewpoint, can be explained based on firms' behaviour when cooperating in supply chains and can be measured as width and depth (e.g. Grant, 2005 and Matopoulos et al., 2007). The former viewpoint involves the scope of activities (i.e. the relationship between firms) in which firms should cooperate while the latter viewpoint signifies the level of activities (i.e. strategic, tactical and operational dimensions) at which firms should cooperate (Sundram et al., 2016).

A supply chain can be defined as goods, information and financial flows through supply, production and distribution from suppliers of the raw materials to the final customers (Grant, 2012). Supply chain members are those performers who carry out processes from the input of raw materials to the delivery of the finished goods. From the viewpoint of firm relationships, they are mutually dependent and these dependencies can create a synergy effect through enhanced integration. In other words, supply chain members can find the origin of any inefficiency through advanced communication and, as a result, they can remove inefficiencies and overlaps. In this situation, firms that focuses on supply chain management (SCM) can achieve real benefits because they can focus on their core competencies.

Many researchers have used the seminal viewpoint of Stevens (1989) on SCI. It explains that integration is achieved between internal functions first and then developed to external

stakeholders (Kotzab et al., 2015). This reflects that SCI creates a flow effect and suggests that full internal, external integration and related interactions will have a positive influence on performance simultaneously (Chen et al., 2009; Boon-itt and Wong, 2011). In addition, Feyissa et al. (2019) observed that internal integration mediates supplier and customer integration. However, Stank et al. (2001) and Bae (2012) noted that external integration also has a positive effect on internal integration and viewed internal and external integration as a separate items. In summary, supply chain members can consider supply chain relationships as a form of integration.

### ***Supply Chain Relationships and SCI***

Research on SCI reflects various viewpoints. Some research on integration has focused on mutual or countervailing relationships for internal implementation within a firm. This viewpoint explains integration based on internal processes as well as functions. Larson (1994) verified the relationships between firms' own departments from the viewpoint of logistics integration. He found that integration can reduce total costs. Integration between marketing and logistics has also been investigated by Ellinger et al. (2000) and Grant (2021) that suggest a causal relationship between integration and performance. Further, factors which have an influence on integration are IT (Tseng and Liao, 2015) as well as top management and managers (Xu et al., 2014). Integration has also been explained as collaboration and interaction within the firm while Stank et al. (2001) ascertained that collaborative behaviour has a positive influence on the effectiveness of relationships between departments. In summary, when cost performance is assessed integrated firms are more profitable than non-integrated firms.

The literature also consider that competition is between supply chains and the role of inter-organize integration and collaboration has been on the increase since (Rajaguru and Matanda, 2009; Bae and Grant, 2018). Key factors influencing SCI include the external environment, information technology (IT), pre-communication and commitment (Iyer, 2011), environmental uncertainty (Wong et al., 2011), blockchain technology (Wang et al., 2020), trust and commitment (Ramirez et al., 2020) and orientation (Bae, 2020). There has also been research concerning factors affecting the relationship between SCI and firm performance such as uncertainty and external integration (Flynn et al., 2010; Wong et al., 2011).

Ayoub et al. (2017) noted that supplier integration and customer integration have a positive relation with both knowledge management and technical innovation while Butt (2019) revealed

that an absence of personal relationship between managers of buying and supplying firms in the supply chain leads to reduced trust. This is because firms are not sharing important business ideas and sensitive information, with no peer mentoring, delay in conflict resolution and low employee engagement.

Childerhouse et al. (2011) proposed a supply chain diagnostics methodology called the Quick Scan in order to examine the uptake of SCI principles internationally and the resultant integration maturity. This method was used to assess level of integration of 72 value streams and benchmark against the four stages of Stevens' (1989) integration maturity model in three case countries. The results found that supply chains are not fully integrated on average, but the levels of integration maturity do not appear significantly different between countries. Thus, SCI may be an accepted generic concept that is not limited by culture, geography, or political establishment. However, the studied organizations faced a high level of uncertainty and fundamental challenges, such as removing internal boundaries and communicating order information along the supply chain.

Almost all the research concerned with integration has been performed from a structural viewpoint with little work done from a behavioural viewpoint. However, from a behavioural viewpoint, certain firms have been found to determine their supply chain width first with tier 1 suppliers and customers and then depth by including tier 2 and beyond relationships (Matopoulos et al., 2007), following the hierarchy noted by Kotzab et al. (2015)

Tsanos et al. (2016) observed that behavioural closeness between supply chain partners enabled the development of collaborative supply chain relationships. This leads to higher integration and superior performance. Using a longitudinal approach incorporating multiple respondents, their main finding was that the integration of information has significant impact on the coordination related to operational decisions. Dekker et al. (2019) examined how individual and organizational control mechanisms influenced the effects of inter-firm collaboration performance and found that boundary spanner relational behavior and inter-organizational controls are positively associated with performance.

Frohlich and Westbrook (2001) suggested five arcs for supplier integration and customer integration and noted that performance compared with stages of integration contained gaps. Thun (2010) connected the five arcs model with IT integration and found that IT was not used

in a wide integrative scope. Reasons given were cost, organizational problems, new technology, using specific technology in the market and data security.

Lastly, Kannan and Tan (2010) investigated relationships between the span of integration, commitment and performance and observed that the span of integration is positively related to relationship performance and firm performance. However, their findings showed there is no relationship between span of integration and cost reduction, market share, return on assets and overall competitive position. Bhakoo et al. (2015) investigated dual arcs of supply chain structures. They discovered that supply chain structure affected supply chain technologies. Thus, while some results found a relationship between the strength of integration and performance, others did not.

### ***Strength of SCI***

Integration between firms is external integration and can be divided into vertical and horizontal integration (Mason et al., 2007). Focal firms generally connect with suppliers and customers using vertical integration, but Vagas et al. (2000) argued that while such integration creates high levels of benefits and enhanced firms' competitiveness, firms still have to focus more on internal rather than external integration. Horizontal integration includes collaborators and competitors of focal firms, for example with logistics service providers, and can also improve service and financial performance of the focal firm (Fabbe-Costes et al., 2009; Hingley et al., 2015; Bae, 2020).

Large width in SCI means firms undertake a high level of integration with various participants in their supply chain, e.g. raw materials suppliers, parts and sub-assembled goods suppliers, wholesalers, retailers, and service providers and enjoy high performance compared with competitors with lower levels of integration (Stevens, 1989). Therefore, width can be ascertained using SCI strength. In this study, width measurement is done through the perceptions of overall magnitude of SCI efforts.

Frohlich and Westbrook (2001) suggested there are arcs of integration for supply chain strategy. Schoenherr and Swink (2012) used these suggestions to investigate relationships between SCI and performance. Bhakoo et al. (2015) used dual arcs of supply chain structures while Thun (2010) verified a relationship between arcs of integration, IT integration and performance while Kannan and Tan (2010) analysed the strength of SCI, i.e. the width of

integration for both suppliers and customers, verifying that SCI is positively related to performance. We hereinafter refer to this as SCI strength.

### ***Supply Chain Cost and Performance***

Beheshti et al. (2014) observed that SCI has a positive influence on financial performance. In addition, Shin et al. (2018) investigated the relationship between shippers and carriers and found that trust in supply chain relationship quality has a positive influence on supply chain performance. Meanwhile, Tsanos and Zografos (2016) demonstrated that coordination of supply side in supply chain relationship quality has a positive effect on performance. Patrucco et al. (2019) highlighted the dynamics of buyer–supplier industrial relationships and the role of customer attractiveness thus confirming that customer attractiveness positively affects both innovation and cost performance. Finally, in studies of relationships with customers and suppliers, it was found that supply chain relationship quality has a positive effect on firm performance (Tan and Ndubisi, 2014) as well as supply chain performance (Odongo et al., 2016).

The core of inter-corporate relationships in supply chains is concerned with information sharing with suppliers and customers (Daugherty, 2011). Market information generated from customers is based on improvement of internal processes of focal firms and it is shared with suppliers, followed by process effectiveness. In terms of supplier innovation, information sharing, and strategic sourcing impact play a positive role in improving supply chain agility (Kim and Chai, 2017). Wahyuddin and Nasirin (2019) noted that if a buyer-supplier relation is flexible, collaborative, and information is shared properly, it will lead to improved competitive advantage in the market.

The literature has also explored the the relationship between SCI integration and performance, from a structural perspective. Bagchi et al. (2005) investigated the relationship between SCI and operational performance and as a result ascertained integration levels that had a positive influence on cost and efficiency. However, they found there was a negative correlation between the length of relationship with suppliers and performance measures. Rajaguru and Matanda (2009) proved the relationship between inter-organizational integration and business performance. They divided integration into inter-organizational information systems (IS) and inter-organizational activity. This had a positive effect on organizational-level supply chain performance and financial performance. In addition, they found that there is a moderating effect



of organizational-level supply chain performance on the relationship between integration and customer responsiveness or service.

Lee et al. (2007) analysed the relationship between SCI and supply chain performance. They verified that supplier and customer linkages have a positive influence on supply chain performance but that the relationship between customer linkage and supply chain performance was weaker than the relationships between other variables and performance. These results all suggest that SCI have a positive effect on performance. However, the relationship between SCI strength and performance is not as clear.

Lee et al. (2016) examined the moderating effects of dynamism on the association between supply chain integration and logistics performance. They suggested that supply chain integration can enhance logistics performance when the level of supply chain dynamic is high. Ataseven and Nair (2017) confirmed that three main dimensions of supply chain integration have a significant impact on a firm's financial and operation: supplier integration, customer integration and internal integration. They argued that internal integration can support the functions of an organization as part of a broader supply chain, whereas, supplier and customer integration emphasize the importance of implementing practices jointly with external parties in order to build relationships that help achieve seamless flow of goods, materials and information along the supply chain.

Martins et al. (2017) analysed the effects of both relational embeddedness (levels of trust and cooperation that firms credit to these relationships) and structural embeddedness (percentage of total costs outsourced with suppliers and sales concentration with clients) with both suppliers and buyers on operational performance in terms of productivity and quality gains. Their findings suggest that collaboration with suppliers captured by relational embeddedness attributes could be used to improve response time and suppliers' cost, with more responsive deliveries in smaller batches thus decreasing safety stocks. Collaboration with clients can increase demand visibility, improve planning, and correct problems related to service quality, production plans, inefficiencies in transport, and surplus or deficiency of products in stock.

These findings were supported by Aharonovitz et al. (2018) who evaluated the effect of logistics collaboration and performance based on shippers, transport carriers, and logistics services providers practices. Their evaluation found that elements of interpersonal skills,

organizational culture, and communication appear to be the most important contributors to logistics performance achievements with relationship history leading to better performance

Adebanjo et al. (2018) found that supply chain relationship/integration has a direct positive impact to innovative capabilities and an indirect positive impact to manufacturing performance. These findings demonstrate that the relationships built with their customers have encouraged them to develop new innovative capabilities.

### ***Summary and Research Gaps***

The SCI literature has various spectra, however there are also limitations based on three perspectives. First, there is no unified measurement method to assess the SCI strength (Fawcett and Magnan, 2002). Second, many researchers have investigated integration by starting from inter-functional areas and expanding to external or intra-functional areas (Stevens, 1989; Kotzab et al., 2015; Bae, 2020). Lastly, there have been limited studies investigating the relationship between SCI strength and performance (Kannan and Tan, 2010).

Prior research has divided SCI according to three areas. One is a focus on internal integration, but this perspective is narrow as SCI extends to inter-firm relationships. The second area is based on external integration and argues that firms can achieve SCI through focusing on suppliers and customers simultaneously. The third area looked at both internal integration and external integration, with some suggestions that SCI develops from internal to external.

However, this third area suffers from four main limitations. The first limitation is that firms do not focus solely on internal or external integration from a strategic perspective. This perspective is similar to Porter's (1980) strategic management theory where, on the basis of their environment, firms focus on internal efficiency or integration if they recognize a stable environment or on external effectiveness or integration if they recognize environmental uncertainty (Kim and Chai, 2016).

Secondly, firms do not properly address cooperation and information sharing between firms if they only have an internal integration as it is one cause of weak supply chain relationships (Grant, 2005). Prior research also explains that SCI can be achieved only with firms, which have already attained internal efficiency through internal integration. Suppliers and customers from the viewpoint of focal firms have different roles to play in supply chain processes.

Therefore, SCI should be explained as a bisectonal perspective, such as supplier integration and customer integration while excluding internal integration.

The third limitation is that excessive internal integration has a negative effect on SCI. The core of SCM is to overcome the internal view of a firm and consequently supply chain participants can achieve overall efficiency through focusing on relationships between firms. If a firm focuses on an internal issues and performs opportunistic behaviour which monopolizes information produced through relationships with other firms to attain its aims, information between firms is then distorted and communication coupled with the construction of efficient processes among firms will become difficult. As a result, the whole supply chain could collapse.

The final limitation is that SCI is not connected with just the first tiers supply chain members. Participants in SCI are also suppliers' suppliers and customers' customers, i.e. the strength of SCI is not simply dyadic or triadic (Fawcett and Magnan, 2002). In order to overcome this limitation, there is a need for multiple insights rather than a simple insight with first tier suppliers and customers. Therefore, integration in supply chain relationships should be tested by the strength of integration that grasps and multiplies relationships with suppliers and customers.

### ***Conceptual Model Development***

A focal firm structures its supply chain relationships through integration with its direct suppliers and customers. The relationships is then expanded to second, third tier suppliers and beyond. The increased SCI strength can help explain supply chain relationships and their impact on performance. Supply chain relationships can be divided into relationships with suppliers and relationships with customers. Supply chain relationships can be illustrated as a 2 x 2 matrix that also serves as our conceptual model (Figure 2). The model or the typology is proposed to measure SCI strength.

**Insert Figure 2 here.**

Integration in supply chain relationships can be classified into relationships with suppliers and customers. We posit that firms in the lower left cell of the matrix, which we term Group 1, have a low relationship with both suppliers and customers. Firms that are included in this

cluster will focus on the efficiency of internal processes. Group 2 in the lower right cell includes firms that have close relationships with suppliers, but less so with customers. They make close relationships with suppliers through systems like electronic data interchange (EDI), just-in-time (JIT) or manufacturing resources planning (MRP). Group 3 firms in the upper left cell structures close relationships with customers, but less so with suppliers. Firms in this cluster structure have relationships with customers through the support of systems like distribution resources planning (DRP). Finally, Group 4 firms in the upper right cell structure superior relationships with both suppliers and customers. In this group, firms maximize the efficiency of processes through removing overlaps and waste because they connect suppliers and customers using IT throughout the whole of these dynamic processes (Lee et al., 2016).

Integration in supply chain relationships was posited as the higher the degree of integration, the higher the strength of integration. A high level of integration means that firms have superior capability in their between-firm relationships. Firms with such capability can thus be regarded as possessing superior capability to manage many supply chain members. This reflects the fact that the strength of integration is higher. In terms of the strength of integration in supply chain relationships, Group 1 has the shortest while Group 2 has the higher strength of supplier integration, Group 3 has the higher strength of customer integration, and Group 4 has the highest strength with both supplier and customer integration.

In this context, Group 1 is considered internally focused. Group 2 is supplier focused and Group 3 is customer focused. In addition, Group 4 is considered as fully integrated supply chains. Firms benefits from highest performance when in Group 4 (Flynn et al., 2010). Therefore, firms' performance through SCI can be ranked as follows: Group 4 is higher than Group 2 and Group 3, which are in turn higher than Group 1.

In summary, we use this conceptual model to investigate whether firms which have higher strength of integration have improved cost performance and responsiveness towards suppliers and customers.

We use social exchange theory (SET) as our theoretical foundation as SCI can be considered based on behaviours in the exchange between supply chain participants. With its origins in seminal sociology (Emerson, 1962; Blau, 1964) and relational marketing (Dwyer et al., 1987; Morgan and Hunt, 1994) literature, SET follows Homans (1958) whereby any interaction

between individual firms is an exchange of resources. The theory further posits that each partner in a relationship must have valuable resource to offer. We use this theory for our study of SCI as SET is considered a central tenet in business-to-business (B2B) and business-to-customer (B2C) relationships (Lambe et al., 2001).

An integrative process brings suppliers, corporate buyers, and other major partners into transactional social exchanges of money, information, and goods. Therefore, relational norms, trust, and reward-sharing are critical to sustain a relationship. A transactional and interactional relationship is strengthened when the partners benefit from its outcomes and will lessen or even be terminated when it is not rewarding (Gouldner, 1960; Grant, 2005). Hence, SET can explain performance achieved through SCI and support the need for closer interaction between organizations, which posits that the basic motivation for integration is the seeking of rewards and avoidance of punishments (Emerson, 1962).

We used well-established measurement variables developed in prior research for testing our hypotheses. Definitions of the variables and measuring methods are as follows. SCI can be defined as the working together, understanding mutual different viewpoints, sharing information and resources and achieving supply chain partners' joint aims (Ellinger et al., 2000; Stank et al., 2001). This means efficient connections between suppliers and customers in order to decrease overlaps and inefficiencies in the whole process. It represents the operational collaboration in the relationships between firms and is divided into customer integration and supplier integration. Performance can be measured based on cost and responsiveness (Brewer and Speh, 2000). The former stands for the degree of cost used in achieving efficiency and the latter represents the degree of improving services in the whole process.

### ***Research Hypotheses Development***

SCI begins with integrated logistics management. Integrated logistics management is defined as a simultaneous working process to minimize total cost through the integration of all logistics activities (Grant, 2012). It includes planning, performing and monitoring the human and physical resources included in procurement, production and distribution. Managers integrate inter-functional processes among supply chain partners to increase value and reduce the waste caused by overlaps and inefficiencies. As a result, SCI between partners has a direct effect on cost savings. In addition, firms achieve SCI through flexible information sharing and communication with suppliers and customers (Stevens, 1989).

Thus, SCI is the basis for achieving efficiency in logistics through flexible communication with customers and collaboration with suppliers. Cost savings can be achieved by standardizing and establishing collaborative activities with supply chain partners. In successful SCI there is efficient logistics operations, productivity, and cost saving.

Firms can acquire information in the supply chain and, consequently, find exchangeable factors among the participants. As a result, managers determine exchangeable factors in the relationships between participants. Firms can achieve a high level of effectiveness through this exchange. In addition, they can achieve cost efficiency in the entire processes through exchange with suppliers and customers.

For this reason, SCI is regarded as a key factor with a positive effect on performance. The literature review has posited that SCI has a positive influence on performance and suggests that the higher the SCI level, the higher the level of performance they achieve. Thus, the strength of integration in supply chain relationships can be the basis of verifying research gaps. As a result, we set out our first hypothesis, H1, as follows.

***H1:** If the strength of integration is higher in supply chains, firms will enjoy higher cost performance.*

An effective relationship between firms is achieved when staff recognised the benefits of working with supply chain partners. Successful SCI depends on whether there is a highly mutually dependent relationship between firms (Stevens, 1989). The effectiveness of the relationship between firms can start based on workers' joint-working initiatives. This can be developed through an understanding of different viewpoints, with information and resources shared, towards a common goal. As a result, firms can achieve aspects of performance such as the correct recognition of customer needs, adaptation to the variance of the market and the flexibility to respond to customer needs.

Thus, SCI has a positive effect on performance as it will reduce working time, develop new products, recognize customer value and achieve superior customer service (Stank et al., 2001). Information sharing is concerned with market information, operational plans and financial information. This will have a positive influence on improving the relationship between firms. Firms need to share plans, forecasts and operational information with supply chain partners,

including suppliers and customers. They can achieve superior supply chain processes through sharing production and sales plans with customers and through the sharing of procurement and production plans with suppliers.

In addition, firms can share market information through collaboration with customers and, consequently, predict variance in the market. Such prediction is reflected in production plans and, consequently, firms can structure efficient customer services through information sharing with suppliers. In addition, real-time information sharing can provide firms with an opportunity to respond rapidly to sudden changes in demand and, as a result, firms can perform collaborative initiatives with partners. Thus, a collaborative attitude between supply chain partners can enhance long-term plans, forecasts and operations. Firms can grasp customer needs and provide customers with superior services through information sharing and collaboration. As a result, we set out our second hypothesis, H2, as follows.

*H2: If the strength of integration is higher in supply chains, firms will enjoy higher responsiveness.*

## **Research Method**

### ***Sampling and Data Collection***

To achieve our research objectives, a questionnaire survey was undertaken with Korean export firms, who were chosen as a population because they import raw materials and export final products and thus relationships between supply chain participants are important; Korea was the eighth biggest export country in the world in 2019. The sample frame was the membership list of Korean International Trade Association. It is representative as a sample frame because most firms which conduct international trade in Korea have joined the association. One thousand (1,000) firms were randomly extracted from the population and solicited to complete the questionnaire. The questionnaire was delivered to managers of marketing or logistics departments as their tacit knowledge makes them informed and reliable informants who understand well the situations of their firms when working with suppliers and customers.

We first qualified respondents by telephone whether the sample firms would respond to the questionnaire before providing details how it could be provided to them. The survey was administered by several methods according to respondent preference, such as mail, e-mail, and Internet link, to stimulate a good response rate. We received 182 usable questionnaires for a

response rate of 18.2%. Before analysing the responses, non-response bias was investigated using Armstrong and Overton's (1977) method for divided into groups in arrival order and there was no significant differences in responses between the first and others groups which means that there is no non-response bias. We verified the gaps among the clusters using analysis of variance (ANOVA) and the results showed that the  $p$  value was not supported at the 5% level.

### ***Analysis Methods***

The reliability and validity of the collected data were tested by various methods. First, the reliability of the items was tested by a Cronbach's alpha coefficient. If a coefficient is over 0.6, reliability is acceptable (Nunnally, 1978). Second, the validity of the items was tested by various methods. Construct validity was tested by convergent validity and discriminant validity. For testing validity, confirmatory factor analysis (CFA) was performed. Six indices of goodness of fit were used for the estimate:  $p$  value on Chi-square (criterion:  $\geq 0.05$ ),  $Q$  (chi-square/df)(criterion:  $\leq 2$ ), Goodness of fit index (GFI, criterion:  $\geq 0.90$ ), adjusted Goodness of fit index (AGFI, criterion:  $\geq 0.90$ ), comparative fit index (CFI, criterion:  $\geq 0.90$ ) and root mean square error of approximation (RMSEA, criteria  $\leq 0.08$ ). For testing convergent validity, this research tested the average variance extracted (AVE). If the AVE is over 0.5, the data are good in convergent validity. Discriminant validity can be tested by comparison of the AVE with a squared pairwise correlation coefficient for each variable. For good discriminant validity, the AVE should be higher than all squared correlation coefficients which include the variable (Nunnally, 1978).

The two hypotheses were tested by cluster analysis and ANOVA. Cluster analysis was conducted in two steps for classifying relationships with suppliers and relationships with customers (Thomas and Venkatraman, 1988). The first was to classify the data within four clusters, high and low groups in the relationship with both suppliers and customers, to insert the number of clusters in K-means. The classified clusters were ascertained to be different clusters using ANOVA. The second step was to test gaps in performance among the clusters using ANOVA to ascertain whether the clusters were different groups with different gaps in performance. IBM SPSS and AMOS were the software tools used for the analyses.



## **Analysis**

### ***General Characteristics of Respondent Firms***

The classifications of the responding firms obtained through the collected data were as follows. As shown in Table 1, 49 firms (26.9%) dealt in metals and non-metals, which was the highest rate. The lowest rate was lumber, paper and furniture firms, which numbered seven (3.8%). Annual turnover also shows various results, with 74 firms (40.7%) are in the US \$1-5 million range and eight firms (4.4%) in the over US \$100 million range. Similarly, the number of employees indicates the volume of responding firms. The lowest is 13 firms (7.1%) in 200-300 employees and the highest is 53 firms (29.1%) below 50 employees. Thus, responding firms present a wide variety.

**Insert Table 1 here.**

### ***Reliability and Validity***

Before testing the hypotheses, the reliability and validity of data were assessed. The former was verified by Cronbach's alpha and the latter was tested by a factor loading coefficient. Construct validity were tested for convergent validity and discriminant validity through confirmatory factor analysis as shown in Table 2.

Customer integration (CI) contains five items while supplier integration (SI) has four. The factor loading coefficient of SI 1 was 0.5, below the threshold of 0.6, and consequently it was deleted from further analysis. Cost performance (CP) has five items and responsiveness (RE) has five. The results of Cronbach's alpha indicate there are no problems in whole variables (CI: 0.89, SI: 0.86, CP: 0.89 and SP: 0.88). The results of confirmatory factor analysis showed a satisfactory goodness of fit indices for exogenous latent variables however a Chi-square coefficient supports the alternative hypothesis. This means that characteristics of the population may not be the same as characteristics of the sample firms. Therefore, generalization of the results needs to be treated with care.

**Insert Table 2 here.**

Correlation analysis has two aims. The first is to test the relationships between independent variables and dependent variables. If the correlation coefficient is high, this suggests that the independent variables and dependent variables are closely related. The second is that it can

analyse the multicollinearity between independent variables. If there are high correlation coefficients between the independent variables, the relationship between the variables should be tested using tolerance and MAX-VIF.

All goodness of fit indices for the convergent validity of exogenous and endogenous latent constructs were satisfactory according to usual criteria (Anderson and Gerbing, 1988). Verification of discriminant validity was tested by comparing the average variance explained (AVE) of each construct with the square of the correlation coefficient between the variables.

The correlation analysis result is shown in Table 3, indicating that the squares of the correlation coefficients are low. In addition, the AVE is larger than the square of the correlation coefficient. Therefore, there is no problem with discriminant validity of the variables.

The correlation coefficient between supplier integration and customer integration in Table 3 is shown as 0.66 and, consequently, an analysis of multicollinearity was performed. If tolerance is over 0.1 and MAX-VIF is below 10.0, the result of analysing multicollinearity is regarded as satisfactory. The result showed that customer integration and supplier integration were both 0.56 in tolerance and 1.78 in MAX-VIF, satisfying the criteria and demonstrating there are no multicollinearity problems. Hence, all data were considered reliable and valid.

**Insert Table 3 here.**

### ***Hypothesis Testing***

The relationships between the variables for verifying the hypotheses were analysed using cluster analysis and ANOVA. The analytical process had two stages. The first was to classify clusters for testing the strength of integration and to verify gaps among the clusters. The second was to verify gaps in performance among the clusters concerned with the strength of integration. The result of the analysis showed that there are four clusters for customer integration (Table 4) and there are also four clusters for supplier integration (Table5).

**Insert Table 4 and 5 here.**

According to Table 5 and 6, firms were classified into. Cluster 1 indicates that all supplier integration and customer integration are low. Cluster 4 indicates that supplier integration is

high, but customer integration is low. Cluster 2 shows that supplier integration is low, but customer integration is high. Cluster 3 shows that all supplier integration and customer integration are high. This is shown in figure 3.

The result of the analysis shows the SCI level of Korean export firms in Figure 3. Cluster 1, the internal focusing level, has 48 firms and they are gathered as a group which focuses on internal processes. Cluster 4, the suppliers-focusing level, has eight firms, which include the lowest number. This shows the cognition on suppliers of Korean export firms. They may not recognize management of suppliers as being important because suppliers have low bargaining power from the viewpoint of Porter (1980). However, they have need of cognition of, and collaboration with, suppliers for SCM. Cluster 2, the customer-focusing level, contains 79 firms. The largest number of firms of the four clusters focuses on customer integration. This reflects the fact that many firms enhance a collaborative level with customers because the relationship with customers has a direct influence on profitability. Lastly, Cluster 3 has 47 firms and, importantly, they treat supplier integration and customer integration simultaneously. They are regarded as the SCI level because of their flexible connection with suppliers as well as customers.

**Insert Figure 3 here.**

The most important aspect of the above result is a comparative viewpoint. Although those in Cluster 4 focus on suppliers, they maintain a high level of customer integration compared with Cluster 1 but lower than Cluster 2 and Cluster 3. In addition, Cluster 2 maintains a high level of supplier integration compared with Cluster 1 but lower than Cluster 3 and Cluster 4, although they focus on customers (see Table 6 and 7). This is similar to Porter's (1980) focused strategy where firms focus on suppliers and/or customers on the basis of recognition of environment. In other words, firms which focus on suppliers (Cluster 4) try to maximize supplier integration from the aspect of maintaining customer integration and firms which focus on customers (Cluster 2) try to maximize customer integration as an aspect of maintaining supplier integration. However, Cluster 1 is composed of firms which focus on their internal processes because they do not yet have recognition of SCI and, on the other hand, Cluster 3 is a group in the SCI level and the firms in the group cooperate efficiently with all suppliers and customers. These classifications of firms are the cause of gaps in performance. Gaps in cost performance and responsiveness among clusters are shown in Tables 6 and 7 respectively.

**Insert Tables 6 and-7 here.**

Table 6 shows there are gaps in cost performance among clusters, thus supporting H1. Cluster 1, the internal focusing stage, has the lowest cost performance. Cluster 3, the SCI level, has the highest score on cost performance (4.63). In addition, Cluster 4, the supplier-focusing stage, and Cluster 2, the customer-focusing stage, are included into a group of Cluster 1 as well as a group of Cluster 3. This means that there are two groups: one is Cluster 1, Cluster 4 and Cluster 2 and the other is Cluster 4, Cluster 2 and Cluster 3. However, Cluster 1 and Cluster 3 are clearly divided into different groups. The result suggests that the highest cost performance can be achieved when the strength of integration with all suppliers and customers is high. In addition, if the strength of supplier integration or customer integration is high, a certain level of cost performance can be achieved but is lower than one of Cluster 3. Therefore, firms can enhance cost performance through grasping their present position in supply chain relationships first and then performing a strategy of supplier integration or customer integration. In addition, if firms want to attain the highest cost performance, they should achieve supplier integration and customer integration together.

In Table 7 there are clear gaps in responsiveness among clusters, thus supporting H2. The firms in Cluster 1 show the lowest responsiveness. They focus on efficiency of internal processes and, consequently, the lack of communication and consistent information sharing with suppliers and customers is a barrier to achieving cost efficiency and service effectiveness from the viewpoint of whole supply chains. Cluster 4 and Cluster 2 show similar levels of responsiveness. This means that responsiveness which is achieved by supplier integration or customer integration is similar. From this viewpoint, the sample firms can enhance responsiveness through increasing the strength of supplier integration. There are just eight firms in this analysis that have a high level of strength in supplier integration. Therefore, the more the firms enhance supplier integration, the higher the responsiveness they achieve. Cluster 3 is a group that shows high supplier integration and the highest customer integration and, consequently, they have the highest responsiveness. The strength of supplier integration represented is the highest in Cluster 4 (Table 5), but responsiveness is shown to be the highest in Cluster 3 (Table 7). Therefore, firms that want to achieve the highest responsiveness should attain supplier integration as well as customer integration (Stank et al., 2001).

## Discussion

SCI is explained by width and depth from a behavioural viewpoint. In SCI, width is decided first followed by depth (Matopoulos et al., 2007). Increasing width means firms can efficiently manage supply chain partners and have a superior capability to manage their partners. As a result, they can enjoy better supply chain relationships with more suppliers and customers. As the number of supply chain partners increases, focal firms can manage their suppliers and customers very well through greater SCI strength, which is measured by perceptions of overall magnitude of effort of SCI and tested by supplier integration and customer integration.

The findings show that the clusters have gaps in cost performance. Firms in Cluster 1, which has the lowest strength of integration, can relatively increase cost performance if they focus on supplier integration (value increases in the analysis were from 3.70 to 4.00) and on customer integration (3.70 to 4.08). If firms in Cluster 4, which has the highest strength of supplier integration, increase customer integration, they can likewise increase cost performance (4.00 to 4.63). Finally, if firms in Cluster 2, which has the higher strength of customer integration, increase supplier integration they can increase cost performance (4.08 to 4.63) (Table 6).

The findings also show that the clusters have gaps in responsiveness. Firms in Cluster 1 can increase responsiveness if they focus on supplier integration (3.46 to 4.30) and customer integration (3.46 to 4.16). The precondition for enhancing their performance is to obtain superior internal resources through recognition of SCI. Firms in Cluster 2 can increase responsiveness if they increase supplier integration (4.16 to 5.23). In addition, firms in Cluster 4 can increase responsiveness if they increase customer integration (4.30 to 5.23) (Tables 4 and 7). Thus, it appears responsiveness is improved more than cost performance when compared to the degree of improved performance. This means that gaps in performance following the strength of integration are clearer in responsiveness than in cost performance.

Cluster 4 has the highest strength of supplier integration (Table 5), but Cluster 3 has the highest responsiveness (Table 7). This suggests that responsiveness is achieved by customer integration rather than supplier integration. Numerically, based on supplier integration Cluster 3 shows 5.50 on average while Cluster 4 shows 5.91 (Table 5). On the other hand, Cluster 3 shows 5.64 while Cluster 4 shows 3.25 based on customer integration (Table 4). There is a large relative gap in the strength of customer integration between these two clusters. In addition, Cluster 4 shows 4.30 and Cluster 3 shows 5.23 for responsiveness (Table 7). Therefore, in this

context responsiveness may be decided by the strength of customer integration. These results indicate that cost performance may be increased, but they are not a direct quantitative increase due to the psychometric Likert scales used (Nunnally, 1978). This is same situation for responsiveness. That is, they provide a relative but not an absolute order of magnitude.

The findings show that performance of Cluster 3, which practices SCM with customers and suppliers is much higher than performance of the other clusters. Further, Cluster 1 focused on internal efficiency. This is explained by SET as Korean exporters develop good relationships with suppliers as well as customers through providing an integrative process of resource exchange through SCI strength, which results in higher performance. For this reason, they need to confirm their position in the supply chain, identify potential relationships with each side of their supply chain participants, and ensure those relationships are well-maintained to level that strength and achieve higher performance (Stank et al., 2001).

This result is different from that of Boon-itt and Wong (2011) where customer integration was found not to be connected to customer delivery performance. However, from the viewpoint of Korean export firms, enhancing the strength of customer integration requires support concerned with marketing, distribution, and service to overseas buyers (Ellinger et al., 2000; Grant, 2021). These firms can then strengthen mutual relationship commitment through high involvement following such support (Kannan and Tan, 2010). Commitment to relationships between firms raises the strength of relationships through mutual collaboration and can make it difficult for their customers to find other suppliers. Therefore, the high strength of customer integration of Korean export firms strengthens responsiveness through increasing the width of integration, which can be an entry barrier for competitors.

Finally, firms should cooperate with suppliers as well as customers to achieve better cost performance (Bagchi et al., 2005; Rajaguru and Matanda, 2009). The findings show that integrative groups (Cluster 2, 3 and 4) have high cost performance compared with the non-integrative group (Cluster 1), and the higher the strength of integration, the higher (or better) the cost performance. Therefore, firms have need of collaborative supply chain operations with both suppliers and customers to achieve cost performance.

## **Conclusions**

This paper contributes theoretically by proposing a model for measuring relationships between firms in a supply chain by verifying gaps in performance resulting from SCI strength using cluster analysis. Further, social exchange theory was used as a lens to explain SCI strength in Korean export firms through relationship interactions and integration among them. To our knowledge this is the first time SET has been used in this manner.

Other researchers and managers can use this method to examine other supply chain contexts to find their relative position and integration classification to improve performance. The method posits four cluster levels of integration classification: internal focusing, supplier-focusing, customer-focusing, and full SCI. Researchers and managers can ascertain levels of customer and supplier integration by using the measurement items developed and we believe this method is a basis of strategic behaviour for performance improvement.

This paper also contributes managerial implications for firms. Firstly, firms should understand and meet customer needs to achieve better responsiveness with suppliers. In this study's context, Korean export firms should maintain close relationships with tier 1 customers comprising overseas wholesalers and retailers to better understand the needs of final customers. They can further achieve synergy through sharing information acquired from these tier 1 customers with their tier 1 suppliers. The result will be enhanced SCI, i.e. a higher strength of SCI, which will in turn enhance cost performance and responsiveness.

There are two limitations as follows along with directions of future research. Firstly, the Chi-square of the exogenous latent constructs is supported at the 5% level. This suggests that the model of the population may not be the same as the model of the sample. However, Chi-square responds sensitively to the number of responses and accordingly may provide more precision if a sample contains over 200 responses. Therefore, further research should ensure sufficient sample size to obtain such precision and enable better generalizability of findings. Secondly, the context of study should be expanded to other supply chain settings across the globe to achieve truly generalizable results.

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### **Declaration of Interest Statement**

The authors reported no potential conflict of interest.

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**Appendix: Questionnaire constructs and measurement items**

Constructs	Measurement Items
Customer Integration (CI)	Close contact with customers Rapidity in processing orders Information sharing with customers Smooth communication with customers Supplying goods/ services in response to customer needs
Supplier Integration (SI)	Exchange of harmonized information with suppliers Participation of suppliers in inventory control Rapid response Network integration with suppliers for stable purchases Stable receipt of goods and services from suppliers
Cost Performance (CP)	Cost savings of labour from reduction and re-disposition of workers Cost savings from decreased stock levels Cost savings from better stock management Cost savings from conformity with order management Cost savings from contacts with partners
Responsiveness (RE)	Increased flexibility of operations through cooperation with partners Ability to fulfill special requirements of customers Ability to supply estimated quantities on time Ability to provide customers with value added services Ability to cooperatively overcome problems with partners

**Table 1: General characteristics of respondent firms**

Type of business	Frequency (%)	Annual turnover	Frequency (%)
Chemistry/Rubber	12 (6.6)	Below U\$1million	22 (12.0)
Electricity/Electronics	39 (21.4)	1-5	74 (40.7)
Metals/Non-metals	49 (26.9)	5-10	20 (11.0)
Machine/Transport/Equipment	14 (7.7)	10-100	26 (14.3)
Fiber/Clothing/Leather	42 (23.1)	Over 100	8 (4.4)
Lumber/Paper/Furniture	7 (3.8)	No answer	32 (17.6)
Food/Beverage	11 (6.0)	<b>Employees</b>	<b>Frequency (%)</b>
Others	6 (3.3)	Below 50	53 (29.1)
No answer	2 (1.2)	50-100	22 (12.1)
<b>Total</b>	<b>182 (100)</b>	100-200	51 (28.0)
		200-300	13 (7.1)
		300-500	15 (8.2)
		Over 500	16 (8.8)
		No answer	12 (6.6)

**Table 2: Confirmatory factor analysis results**

Items	Factor loading	AVE	Critical ratio	Goodness of fit
CI 1	0.651	0.613	9.169***	Chi-square= 36.420 (p=0.020) df=21 Q=1.734 GFI=0.959 AGFI=0.912 CFI=0.985 RMSEA=0.064
CI 2	0.732		10.599***	
CI 3	0.844		12.606***	
CI 4	0.870		13.149***	
CI 5	0.797		-	
SI 2	0.650	0.645	9.350***	Chi-square= 25.728 (p=0.175) df=20 Q=1.286 GFI=0.973 AGFI=0.926 CFI=0.995 RMSEA=0.040
SI 3	0.827		14.075***	
SI 4	0.850		13.984***	
SI 5	0.867		-	
CP 1	0.719	0.606	7.742***	Chi-square= 25.728 (p=0.175) df=20 Q=1.286 GFI=0.973 AGFI=0.926 CFI=0.995 RMSEA=0.040
CP 2	0.899		8.551***	
CP 3	0.908		8.963***	
CP 4	0.723		9.880***	
CP 5	0.599		-	
RE 1	0.564	0.595	8.290***	Chi-square= 25.728 (p=0.175) df=20 Q=1.286 GFI=0.973 AGFI=0.926 CFI=0.995 RMSEA=0.040
RE 2	0.792		12.743***	
RE 3	0.815		13.213***	
RE 4	0.787		12.544***	
RE 5	0.865		-	

Notes: \*\*\* = p &lt; 0.01

**Table 3: Correlation analysis results between constructs**

	Average	S.D.	CI	SI	CP	RE
CI	4.101	1.280	1.000			
SI	3.937	1.405	0.661*** (0.437)	1.000		
CP	4.118	1.150	0.331*** (0.110)	0.283*** (0.080)	1.000	
RE	4.257	1.150	0.588*** (0.346)	0.573*** (0.328)	0.622*** (0.387)	1.000

Notes: \*\*\* = p &lt; 0.01; Numbers in parenthesis are the square of the correlation coefficient

**Table 4: Cluster analysis of customer integration**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>ANOVA (F)</b>
CI	Cluster 1 (n=48)	2.641	3.250	4.159	5.638	168.642 (p < 0.000)
	Cluster 4 (n=8)					
	Cluster 2 (n=79)					
	Cluster 3 (n=47)					

**Table 5: Cluster analysis of supplier integration**

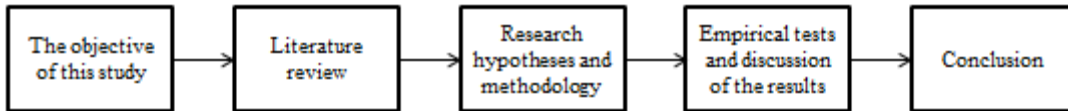
		<b>1</b>	<b>2</b>	<b>3</b>	<b>ANOVA (F)</b>
SI	Cluster 1 (n=48)	2.649	3.772	5.550	180.662 (p < 0.000)
	Cluster 2 (n=79)				
	Cluster 3 (n=47)				
	Cluster 4 (n=8)				

**Table 6: Results of cost performance gaps among clusters**

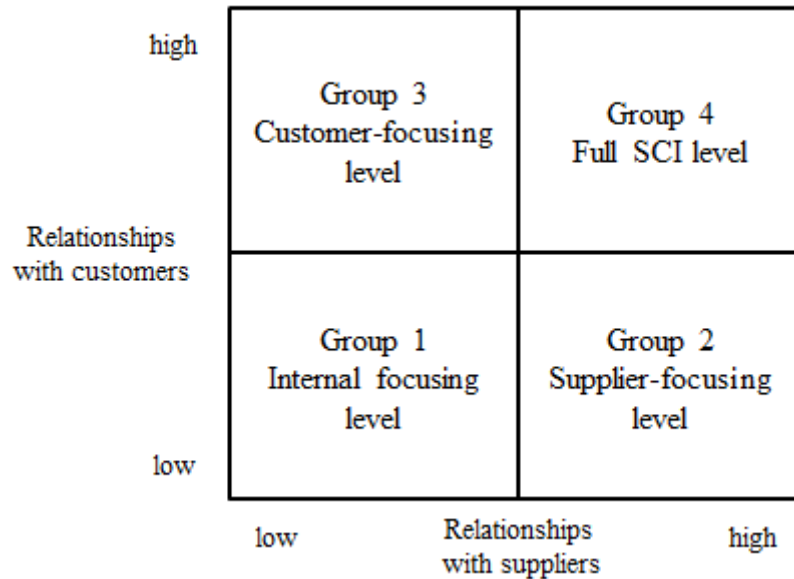
		<b>1</b>	<b>2</b>	<b>ANOVA (F)</b>
CP	Cluster 1 (n=48)	3.696	4.000	5.797 (p < 0.000)
	Cluster 4 (n=8)	4.000		
	Cluster 2 (n=79)	4.079		
	Cluster 3 (n=47)	4.634		

**Table 7: Results responsiveness gaps among clusters**

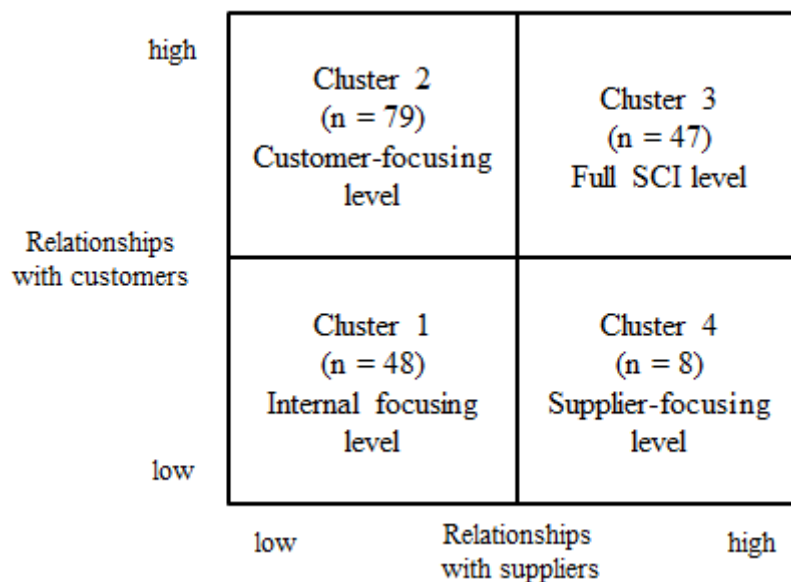
		<b>1</b>	<b>2</b>	<b>3</b>	<b>ANOVA (F)</b>
RE	Cluster 1 (n=48)	3.463	4.157	5.230	27.360 (p < 0.000)
	Cluster 2 (n=79)				
	Cluster 1 (n=48)		4.300		
	Cluster 3 (n=47)				



**Figure 1: Flowchart of this study**



**Figure 2: Conceptual classification of integration within supply chain relationships**



**Figure 3: The result of the cluster analysis on customer and supplier integration**