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Abstract

Purpose – The purpose of this paper is to employ a newly developed framework to examine the complex relationship between different components of supply chain practices, supply chain integration (SCI) and supply chain performance (SCP) in the Malaysian electronics sector.

Design/methodology/approach – This study utilizes survey data of 156 electronics firms in Malaysia and tested the research framework and hypotheses. In addition to the traditional approach of Barron and Kenny (1986), the Sobel test as well as a bootstrapping approach, which is deemed for small sample size, is used to formally test the indirect effects of SCI in the model.

Findings – SCI has fully and partially mediated the relationship between supply chain management practices (SCMPs) and SCP. SCI fully mediates the relationship between SCP and three of the SCMPs, namely, information quality, agreed vision and goals and postponement strategies. The relationship of supply strategic partnership, customer relation management, information sharing with SCP were partially mediated by SCI. Risk and reward sharing is found to be non-significant. These insights allow managers to effectively utilize the different components of SCMPs for SCI and performance.

Practical implications – For supply chain practitioners, the results of the study can be useful in integrating SCMPs and SCI on improving SCP. Practitioners should take into account the mediating effect of SCI in designing their supply chain management approach to production.

Originality/value – To the authors' best knowledge, this paper is one of the first to address the mediating effect of SCI between SCMPs and overall performance of the supply chain.

Keywords Competitiveness, Business performance, Company performance, Business excellence, Supply chain performance, Supply chain integration, Supply chain practices

Paper type Research paper

1. Introduction

The study of supply chain management has emerged as a prominent field in providing organizations with strategies to build long-term competitiveness (Azadi *et al.*, 2014; Boon-itt and Paul, 2006; Mortensen *et al.*, 2008). Supply chain management has the ability to promote the integration of organizations which was previously independent, for improving in organizational collaboration (Ajmera and Cook, 2009; Zhang *et al.*, 2015). Research shows that integrative organization collaboration enhances organizational

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performance (Green *et al.*, 2006; Tracey and Tan, 2001) and SCP (Gunasekaran *et al.*, 2004; Otto and Kotzab, 2003). Within the areas of supply chain management, literatures highlight the need to understand supply chain management practices (SCMPs) which have become an essential prerequisite to remain competitive in the global race with profitable growth (Moberg *et al.*, 2002; Okongwu *et al.*, 2015; Power *et al.*, 2001; Sezen, 2008). In addition, the strategic nature of SCMPs will be able to explain the dual purpose of supply chain management: to improve the performance of an individual organization, and to improve the performance of the entire supply chain (Wong *et al.*, 1999). In order to be highly competitive and at the same time achieve sustainable profitability growth, supply chain management seeks close integration of internal functions within the firm and external linkages with suppliers, customers and other channel members. This could be achieved through the effective construction of various SCMPs (Kim, 2006). Although some organizations have realized the importance of implementing supply chain management, they often do not know exactly what to implement, due to a lack of understanding of what constitutes a comprehensive set of SCMPs (Li *et al.*, 2006a, b). Furthermore, given the failure of so many supply chain management efforts to yield the desired improvements in performance, the question remains whether SCMPs can positively impact performance (Handfield and Nichols, 1998; Tan *et al.*, 1999).

Although current literatures give us a clear understanding of the link between SCMPs and firm performance, there is far too little knowledge available on the role of supply chain integration (SCI) in mediating the influence of SCMPs and performance. The extant literature, so far, has only examined either the link between SCMPs and firm performance (Veera *et al.*, 2011; Khan *et al.*, 2009; Robb *et al.*, 2008; Sari, 2008) or SCI and firm performance (Handfield *et al.*, 2009; Zelbst *et al.*, 2009; Zolait *et al.*, 2010), respectively[1]. The existing gaps in the literatures are as follows: first, a more integrated model examining the complex link between SCMPs, SCI and SCP is still missing. Therefore, examining the issues of how SCMPs and performance is mediated by the SCI is still fuzzy. More importantly, the main gaps in the current literature are the lack of empirical evidence on the relationship between SCMPs, integration and performance. Second, research gaps also include the lack of empirical analysis on how and which component of SCMPs is important for SCI as well as for SCP. And, notably, managers are also seeking to find answers on which SCMPs are likely to be mediated by SCI that can consequently enhance performance. The insights from this study will allow managers to effectively utilize the different components of SCMPs for SCI and performance. Third, most often scholarly work tends to overly focus on firm performance rather than SCP. This study, therefore, inclines to explicitly focus on SCP. This study, an extension of our earlier study (Veera *et al.*, 2011), uses larger sample size as well as a complete framework to examine the mediating role of SCI.

Overall, this study describes a research effort that addresses the above questions. The main purpose is to disclose the interrelationships among the three main constructs; SCMPs, SCI and SCP. The theoretical gaps this study address are of importance because there are no empirical researches that simultaneously examine the mediating effect of SCI. This paper aims to fill this gap through a quantitative research into Malaysia's electronics manufacturing industry. Apparently, scholarly research in the area of SCMPs with respect to the application in developing countries, especially Malaysia, is scant. In addition, there has been limited scholarly research investigation undertaken to present a theoretical viewpoint, supported by empirical evidence (Basnet *et al.*, 2003), on how SCMPs yield performance in particular SCP.

Besides this, there are several other reasons which purported the study to confine the analysis within the electronics industry in Malaysia. The Malaysian electronics industry is the leading and most significant contributor in terms of manufacturing output, exports volume and employment opportunity in comparison to other resource- and non-resource-based industries (Salleh and Mohammad, 2007). More specifically, in 2006, the total output of the electrical and electronics industry was approximately RM214.9 billion. Further, the exports of electrical and electronics products was approximately RM282.2 billion or 61.7 percent of total manufactured exports (MIDA, 2007). This huge volume of production and international trading of electrical and electronics has created 397,553 jobs opportunities, amounting to 36.6 percent of the total employment in the manufacturing sector (Tan *et al.*, 2008). Hence, Malaysia's electronics manufacturing industry developed into a relatively important contributing sector in making Malaysia one of the leading exporters of semiconductor, room air conditioners, telecommunication equipment, computers and computer peripherals (FMM, 2004). Furthermore, due to foreign direct investment, the electronics industries have relatively developed higher export capabilities. Thus, it is postulated that there would emerge some spillovers to the other industries within the cluster. Also, due to the modular nature of these industries, more technological spillovers would have naturally occurred in these industries as compared to the other industries (Best, 2007; Best and Rasiah, 2003; Rasiah, 2008, 2009a, b). It is these factors that have motivated the study to select the electronics manufacturing sector as the research case study. In terms of supply chain implementations, these industries are well placed in Malaysia. Given the influence of multinational corporations, many local firms have also engaged in SCMPs. Indeed, sector-specific studies are required since the characteristics of SCMPs differs among sectors (Zailani and Rajagopal, 2005) and by emphasizing the electronics sector, in this study, a more robust analysis can be formulated avoiding the heterogeneity problems.

2. Literature review and research framework

An important task in examining the link between SCMPs, SCI and SCP is to develop a robust theoretical foundation that enables the study to further develop the model and hypothesis. In doing so, first, we clarify the concept of SCMPs, SCI and SCP used in this study. Subsequently, the theory, model and hypothesis are further developed and explained.

2.1 SCMPs

SCMPs are regarded as operational functions or activities of an organization which determines the effectiveness and efficiency of its supply chain (Sandhu *et al.*, 2013). Donlon (1996) identifies several components of SCMPs which encompass supplier partnering, information sharing, process flow and outsourcing. These components are considered the current evolution of SCMPs, especially in the manufacturing industry. The empirical work of Tan *et al.* (1998a, b) classifies quality management, procurement and customer relationship management in SCMPs. Alvarado and Kotzab (2001) selected information technology and customization through postponement activities as an important aspect of SCMPs. Tan (2001) further supported that information sharing among trading partners in a supply chain, such as mass customization and postponement are crucial SCMPs that ensure a well-integrated supply chain. Therefore, SCMPs are regarded as a perfect recipe for the success of several firms from various industries (Gorane and Kant, 2015; Kayakutlu and Buyukozkan, 2010). Tan *et al.* (2002)

developed six dimensions of SCMPs, namely, supply chain characteristics, customer service management, geographical proximity, SCI, just-in-time capability and information sharing. Whereas, Chen and Paulraj (2004) employed several other dimensions such as supplier base reduction, long-term relationship, communication, cross-functional teams and supplier involvement to measure SCMPs. In relation to this, Min and Mentzer (2004) included seven important variables to conceptualize SCMPs, namely, supply chain leadership, risk and award sharing, agreed vision and goals, information sharing, long-term relationship, process integration and cooperation.

2.2 SCI

SCI is defined as the extent to which all activities within an organization and the activities of its suppliers, customers and other supply chain members are integrated (Flynn *et al.*, 2010; Narasimhan and Kim, 2002; Rai *et al.*, 2006; Stonebraker and Liao, 2006). SCI links a firm with its customers, suppliers and other channel members by integrating their relationships, activities, functions, processes and locations (Kim and Narasimhan, 2002; Naslund and Hulthen, 2012). SCI includes two stages: internal integration between functions and external integration with trading partners. Internal integration establishes close relationships between functions such as shipping and inventory or purchasing and raw material management (Trkman and Groznik, 2006). While external integration has two directions: forward integration for physical flow of deliveries between suppliers, manufacturers, and customers and backward coordination of information technologies and the flow of data from customers, to manufacturers, to suppliers (Frohlich and Westbrook, 2001; Schoenherra and Swink, 2012). Based on this discussion, several measurement items were selected and adopted (Sezen, 2008) to measure SCI.

2.3 SCP

For any business activity, such as supply chain management, which has strategic implications for any company, identifying the required performance measures on most of the criteria is essential and it should be an integral part of any business strategy (Chia *et al.*, 2009). SCP has been defined as a systematic process of measuring the effectiveness and efficiency of supply chain operations (Anand and Grover, 2015; Neely *et al.*, 1997). This SCP measurement also promotes collaborative integration among members of the supply chain in a specific industry (Garengo and Bititci, 2007). The effective SCP monitoring helps firms to ensure that they are on the path to financial stability and service excellence (Whalen, 2002). As Milliken (2001) points out, an effective SCP measurement process is critical to ensure continuous improvement in the supply chain processes. According to Cooke (2003), what gets measured gets managed. The author's argument that, what gets measured, gets done is only true if a manageable number of metrics, which focusses on business success, are used. According to Tompkins and Ang (1999), the greatest challenge related to SCP measurement has to do with having the people administering the measurement to focus, not on their individual link in the chain, but on the real performance of the entire supply chain. Furthermore, Chan and Qi (2003) argue that performance measurement should take a holistic system perspective beyond the organizational boundaries. All the participants of supply chains are intended to share mutual customer-focussed goals and cooperatively provide products and services that satisfy customers' requirements. Subsequently, the performance of supply chain needs to be assessed across the organizations, so as to encourage global optimization along the supply chain channels.

2.4 Theory, framework and hypothesis

Following a detail review of several literatures on theoretical perspective, the main theoretical foundation employed to build the proposed framework is the resource-based view (RBV) of firm. The RBV of firm theorizes that unique bundle of resources owned by firms is expected to explain the variation in firm performances (Barney, 1991) which includes the firm's capabilities. These resources include the SCM capability, i.e. SCMP and SCI capabilities (Blome *et al.*, 2014; Sari, 2008; Trkman *et al.*, 2007; Maheshwari *et al.*, 2006; Sánchez-Rodríguez *et al.*, 2005). In this study, similar to the RBV definition of capability, SCMP are viewed as the firms' ability or potential ability to form strategic supplier partnership (SSP), establish CR and ability to share information, vision, goals and risks. In other words, this study conceptualizes SCMP as the supply chain capability to include the seven main constructs mentioned in the proposed framework. Furthermore, these capabilities do not only link the firm's internal operations but also the firm and its suppliers and customers that are important to utilize the resources effectively and efficiently (Blome *et al.*, 2014). As such, organizations embarking on supply chain need to focus on the ability of organizational skills and processes in practicing those elements of SCMP. Thus, organizations that implement SCMP could improve its performance and eventually achieve competitive advantage. Recent studies using RBV in the context of SCM include (Gligor and Holcomb, 2014; Hwang and Min, 2015; Jin and Edmunds, 2015; Zolait *et al.*, 2010). These studies, although limited in the context of emerging markets, provide interesting accounts on the use of RBV in the context of supply chain practices, integration and performance. Therefore, the RBV is considered the main lens in this research that focusses mainly on SCMP as the main capabilities of firms.

The research framework developed in this study is shown in Figure 1. Further, this section describes the research model as well as the nine main hypotheses. The framework proposes that supply chain practice implemented in the electronics manufacturing industry will influence SCP directly and indirectly through the

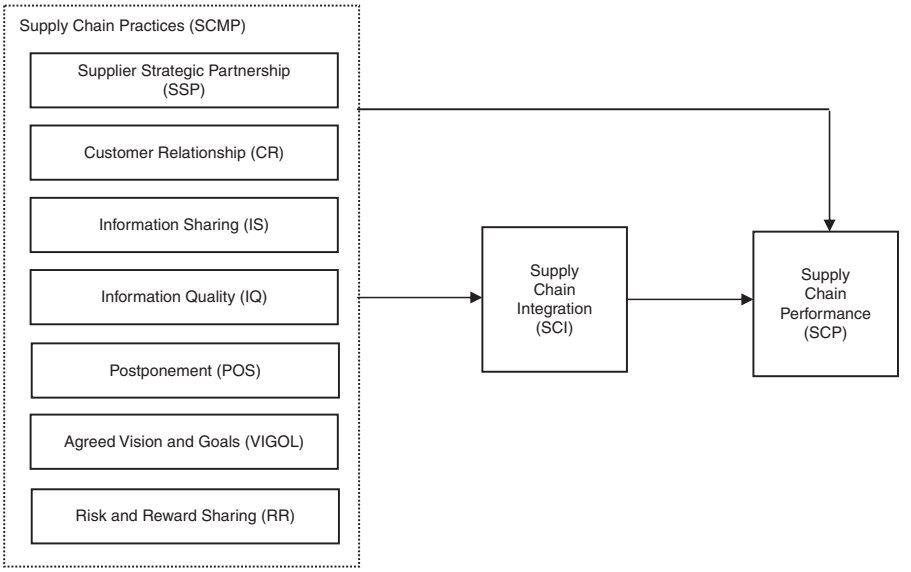


Figure 1.
Research framework

intervention of SCI as mediating variable. Fundamentally, the research model is based on the premise that a change in SCP is related to the change in SCMPs dimensions such as supplier strategic partnership, customer relationship, information sharing, information quality, postponement, agreed vision and goals and risk and award sharing. It also proposes that such a relationship is mediated by the SCI. Each of the stated relationships are further explained with empirical support from the past studies. A detailed description of the SCMPs dimensions along SCI and SCP constructs are provided in Tables II and III. Based on the extensive literature, the proposed relationships between SCMPs, SCI and SCP are further discussed and hypotheses related to these variables are developed.

2.4.1 Mediating effect of SCI. This paper mainly focusses on the mediating role of SCI in influencing the relationship between SCMPs and SCP. Implicitly, the discussion suggests that SCMPs affect SCP through their capacities in SCI. That is, firms in the electronics industry can use a set of supply chain practices to promote the integration of various firms in the supply chain (Kim, 2006; Li *et al.*, 2006a, b; Pramatari, 2007), which, in turn, enhance their SCP (Baharanchi, 2009; Fabbe-Costes and Jahre, 2007; Gimenez and Ventura, 2005). This suggests that the effect of SCMP on performance might not be direct and universal. Rather, it might depend on the integrative capabilities of an organization within and across the supply chain through the implementation of SCMP. Thus, this study argues that SCI plays a mediating role in the relationship between independent variables of SCMPs and dependent variable of the supply chain. Following this line of reasoning, this study proposes the following general hypothesis:

H1. The SCI mediates the relationship between SCMPs and SCP.

In the next section the preceding hypotheses link the relationships among specific SCMPs, SCI and SCP is developed in more detail.

2.4.2 SSP and SCI. Strategic suppliers' partnership practices nurture a significant long-term relationship among members of the supply chain (Li *et al.*, 2005; Qrunfleh *et al.*, 2012). This strategic relationship will improve organizational capabilities (Holt and Ghobadian, 2009) and collaborative integration among trading partners in a supply chain (Kim, 2006). In addition, an effective supplier partnership provides opportunities for mutual planning and joint problem solving efforts among members in a supply chain (Gunasekaran *et al.*, 2001). Hence, strategic supplier partnering practices in the long term enable an organization to have strong integrated and collaborative relationship to achieve ongoing performance (Pramatari, 2007). As such the following hypotheses were developed:

H2a. The strategic supplier's partnership relates positively to SCI.

H2b. SCI mediates the relationship between supplier strategic partnership and SCP.

2.4.3 Customer relationship and SCI. Customer relationship practices are referred as a set of practices which is employed by an organization to fulfill several essential customer requirements which include, managing customer relationship, customer complaints and enhanced customer satisfaction (Tan *et al.*, 1998a, b). An organization which provides valuable customer relationship enables them to differentiate its product from competitors (Cox, 2004; Dadzie and Winston, 2007). Subsequently this could build a strong customer based through improved customer satisfaction and customer loyalty (Elofson and Robinson, 2007). In addition, the requirement for mass customization and

personalized service has made customer relationship an important SCMPs (Wines, 1996). Therefore, the customer relationship is an important element for improving relationship coordination and collaborative efforts across members of the supply chain (Wadhwa *et al.*, 2006). Based on the above discussion, this study consequently proposes the following hypothesis:

H3a. The customer relationship relates positively to SCI.

H3b. SCI mediates the relationship between customer relationship and SCP.

2.4.4 Information sharing and SCI. Information sharing refers to the extent to which information is communicated effectively among supply chain members (Li *et al.*, 2006a, b; Mentzer *et al.*, 2001). Many researchers have highlighted the essentials of information sharing practices in a supply chain (Fiala, 2005; Lee *et al.*, 2000; Strader *et al.*, 1999). Supply chain members who share information regularly and frequently are able to work collaboratively as a single entity (Stein and Sweat, 1998). Eventually, members or partners in the supply chain could understand each other better and, accurately respond to ever changing customer requirements (Collin *et al.*, 2009). Furthermore, through effective and efficient dissemination and exchange of information the supply chain is hastened and accurate decision making is made possible. This can be viewed as a source for the competitive advantage (Moberg *et al.*, 2002). This study therefore proposes the following hypothesis:

H4a. The information sharing relates positively to SCI.

H4b. SCI mediates the relationship between information sharing and SCP.

2.4.5 Information quality and SCI. Information quality includes all aspects of managing information and communicating effectively and efficiently in terms of accuracy, timeliness, adequacy and credibility (Li *et al.*, 2006a, b). Many research studies provided sufficient evidence that a proper management of information quality within and across the organization could be a source of the competitive advantage (Kim, 2006; Koh *et al.*, 2007). Forslund and Jonsson (2007) noted that information quality exchange and practices among partners in a supply chain enables them to coordinate supply chain activities effectively well. Organizations should view information quality practices as an integrative strategic tool and guarantees there will be no distortion or manipulation in the information flow (Gustavsson, 2008). Hence, this will not only improve the decision-making process but also helps obtain the best supply chain operational solution (Alvarez, 1994). Accordingly, the following hypotheses were developed:

H5a. The information quality relates positively to SCI.

H5b. SCI mediates the relationship between information quality and SCP.

2.4.6 Postponement and SCI. Postponement here refers to an activity of delaying certain operations to a later point in time or a stage in a supply chain, with an intention of bringing added value to the product or to promote greater customer satisfaction (Beamon, 1998; Naylor *et al.*, 1999). Postponement requires an organization to be more operationally flexible (Hoek *et al.*, 1999), functionally integrative (Yang *et al.*, 2007) and customer responsive in order to meet changing customer needs (Yeung *et al.*, 2007) and to differentiate a product (Hoek, 2001). As such, the success of postponement practices depends significantly on the ability of an organization to be more integrative internally

across all functional departments and externally across trading partners (Cvsa and Gilbert, 2002; Ernst and Kamrad, 2000; Hoek, 2001). In a nutshell, postponement in the long run enables organizations in the supply chain to reduce inventory holding and this, in turn, increases SCP (Yang *et al.*, 2007). Based on the existing work, this study consequently proposes the following hypotheses:

H6a. The postponement relates positively to SCI.

H6b. SCI mediates the relationship between postponement and SCP.

2.4.7 Agreed vision and goals and SCI. In a competitive global market, the success of a business operation is heavily dependent on the strategic relationship and collaboration among partners (Boddy *et al.*, 2000; Lambert *et al.*, 1998). To achieve this sustainable relationship among supply chain partners, information sharing, trust and commitment is regarded as an important virtue of business philosophy (Nasurdin *et al.*, 2008). Hence, to ensure effective information sharing, trust and commitment among supply chain trading partners, organizations should establish agreed vision and set common goals among members in the supply chain (Spekman *et al.*, 1998). Eventually, this will ensure the success of SCMPs in achieving sustainable internal and external SCI (Samaranayake, 2005). As discussed above, this study proposes the following hypotheses:

H7a. The agreed vision and goals relate positively to SCI.

H7b. SCI mediates the relationship between agreed vision and goals and SCP.

2.4.8 Risk and reward sharing and SCI. Risk and reward management is becoming more essential as a result of increasing global market and the growing complexity of the supply chain (Kleindorfer and Van Wassenhove, 2004). Effective risk and reward sharing practices among supplier, manufacturer, distributor and customer should be given serious consideration if an organization wants to strategically approach the current competitive local and global market (Min and Mentzer, 2001). The risk and reward sharing practices will ensure relationship building among supply chain members and subsequently nurture strong collaboration among trading partners (Hall, 1999). This, in turn, helps the organization and its members reduce the uncertainty level in the business operations in terms of technology, customer or market focussed initiatives (Ritchie and Brindley, 2007). Therefore, the following hypotheses were developed:

H8a. The risk and reward sharing relates positively to SCI.

H8b. SCI mediates the relationship between risk and reward sharing and SCP.

2.4.9 SCI and SCP. SCI is regarded as collaboration between various value chain entities to achieve a seamless flow of products and information from supplier and on to the customer (Donk *et al.*, 2008). There are also numerous papers suggesting the introduction of SCI mechanism to improve the flow of goods and information across and within the supply chain (Exon-Taylor, 1996; Koufteros *et al.*, 2005; Lee *et al.*, 2007). This implies that, SCI is one of the possible tools to enhance firms' competitiveness and delivery of performance. Similarly, such efforts can improve the SCP. Thus, the following hypothesis was developed:

H9. The SCI relates positively to SCP.

3. Methodology

3.1 Sampling

This study primarily uses individual firms in the manufacturing sector particularly electronics firms as a unit of analysis. The main reason to focus only on electronics industry is to reduce the heterogeneity in SCMPs. In addition, selecting companies from different manufacturing sector may also pose difficulties in controlling certain characteristics of supply chain configuration such as supply chain design. A total of 600 electronics firms were randomly selected from Information Service of Statistical Department, Malaysia. The survey was carried out in a period of six months. Due to low response rate several initiatives were taken to improve the response rate including repeated follow-up calls, as well as giving assurance of mailing the results of the study for the respective companies' future reference. Even, a presentation of the results was offered to the respective companies upon completion of the study, so as to assist company personnel in making plausible and informed decision with regards to supply chain management. As a result, 171 questionnaires were finally received and the final response rate was 28.5 percent[2]. After eliminating the incomplete survey, 156 questionnaires were kept with a 26 percent of valid returned rate. Since there were late replies to the survey, the extrapolation technique was employed to test the likelihood of non-response biases, equating late responses to non-respondents (Armstrong and Overton, 1977) cited by Cousins and Menguc (2006). This was carried out by splitting the total sample into two groups: sample respondent received before the second wave of mailing ($n = 74$), and sample respondent received after the second wave ($n = 82$). In order to compare these two groups in terms of the mean responses on each variable, *t*-test was used. The results revealed no significant differences between the two groups. As a result, the study respondents were not different from non-respondents. For example, it was found that there were no statistically significant differences between respondents and non-respondents based on the mean scores of the constructs used such as supplier strategic partnership ($t = 0.85$; $p = 0.68$); customer relationship ($t = 0.98$; $p = 0.43$); information sharing ($t = -1.15$; $p = 0.38$); information quality ($t = 1.37$; $p = 0.24$); postponement ($t = 0.50$; $p = 0.41$); agreed vision and goals ($t = -0.89$; $p = 0.37$); risk and reward sharing ($t = -0.78$; $p = 0.36$); SCI ($t = -0.89$; $p = 0.37$); SCP ($t = -0.89$; $p = 0.40$) and based on responses to such demographic characteristics as operating experience ($t = -0.81$; $p = 0.54$); numbers of employee ($t = -0.05$; $p = 0.85$); annual sales ($t = -0.49$; $p = 0.51$).

This study hypothesizes that firms with SCMPs should have better effects on various levels of SCI and SCP. In order to examine the relationship between SCMPs, SCI and SCP, this study used firms of various sizes from the electronics industry in Malaysia to be the sampling target to investigate the effects of SCMPs implementation. Demographic data shown in Table I depicts that the majority of the firms' respondents is from electronics component, which constitute 58.33 percent of the total firm sample. In terms of location, the majority of the firms' respondents are from Northern and Southern region of Malaysia. The command numbers of employees are between 250 and 500 or above. Almost all the selected firms in this study have 5-20 years of operational experience.

3.2 Instrument and measurements

Measurement of SCMPs, SCI and SCP were necessary to test the study hypotheses and also to address the objectives of this study. A survey questionnaire was developed based on the literatures and consisted of four main sections, including the respondents' profile, SCMPs, SCI and SCP constructs.

Business description	*n*	%	Number of employees	*n*	%
Component	91	58.33	Fewer than 50		–
Industrial electronics	35	22.44	50-100	20	12.82
Consumer electronics	30	19.23	101-250	26	16.67
			251-500	61	39.10
			501 or greater	49	31.41
Annual sales	*n*	%	Operating experience	*n*	%
Less than 1 million		–	Less 1 year		–
1-5 million	30	19.23	1-5 years	15	9.62
5-10 million	41	26.28	6-10 years	20	12.82
10-50 million	54	34.61	10-15 years	61	39.10
50-100 million	20	12.82	15-20 years	49	31.41
More than 100 million	11	7.05	More than 20 years	11	7.05

Table I.
Description of the respondent firms

The SCMPs were measured using SCMPs scale developed by Li *et al.* (2005, 2006a, b), which included SSP, customer relationship, information sharing, information quality and postponement as the main dimensional construct of SCMPs. In addition, another two dimensions – agreed vision and goals and risk and reward sharing were included following the earlier study by Min and Mentzer (2004) and Bowersox *et al.* (1999). A total of seven constructs (see Table II) which are considered important for effective SCMPs are proposed for measuring SCMPs. This measurement considers the SCMPs from within the whole system of supply chain that includes upstream, downstream, internal process, across the supply chain and system orientation. Therefore, the new SCMPs construct is viewed as a more comprehensive concept in comparison to the narrow view taken in previous researches (Alvarado and Kotzab, 2001; Basnet *et al.*, 2003). Questions related to SCI measures were developed based on the instrument items previously used by Sezen (2008) and Wisner (2003). Both the SCMP and SCI construct employed a seven-point Likert scale with a score of 1 indicating "strongly disagree" and 7 representing "strongly agree" to represent the different attitudes of respondents. Likewise, construct measuring dimensions of SCP were adopted from Koh *et al.* (2007). We used a seven-point scale as a unit of measurement ranging from "definitely worse" to "definitely better" in relation to their major competitors. The questionnaire was pre-tested by two professionals in practice. Based on expert advice of the professionals, several questions were either omitted or rewritten.

3.3 Reliability and validity

Factor analysis and Cronbach's α analysis were performed to verify the dimensionality and reliability of each construct. Factor analysis was used to examine the multidimensionality of SCMPs. The finding acquired from this analysis indicated that the main construct of SCMPs is the multidimensional variable comprising seven dimensions with 32 items. The multicollinearity between the produced factors was checked and the value of Kaiser-Meyer-Olkin; which is a measure of sampling adequacy, was found to be 0.773. Since this value is more than 0.5, it can be suggested that the factor analysis test has proceeded correctly and that the sample was used adequately. As such, it can be concluded that the matrix did not suffer from multicollinearity or singularity. In addition, the result obtained from the Barlett test of sphericity showed that it was highly significant (sig. = 0.000). This shows that the factor analysis processes were correct and suitable for testing multidimensionality. The results of factor analysis are shown in Table II. For the final analysis we removed those items that scored below 0.7.

Construct and items	Factor loading
Supply chain management practices (SCMP)	
Strategic supplier partnership (SSP)	
Organization considers quality as number one criterion in selecting suppliers	0.818
Organization regularly solve problems jointly with its suppliers	0.804
Organization helps its suppliers to improve their product quality	0.860
Organization has continuous improvement programs that include its key suppliers	0.730
Organization include its key suppliers in its planning and goal setting activities	0.851
Organization actively involves its key suppliers in new product development processes	0.762
Customer relationship (CR)	
Organization frequently interacts with customers to set its reliability, responsiveness and other standards	0.748
Organization frequently measures and evaluates customer satisfaction	0.813
Organization frequently determine future customer expectations	0.784
Organization facilitates customers' ability to seek assistance from it	0.541
Organization periodically evaluates the importance of its relationship with its customers	0.726
Information sharing (IS)	
Organization informs its trading partners in advance of changing needs	0.682
Organization's trading partners share proprietary information with your organization	0.702
Organization's trading partners keep your organization fully informed about issues that affect its business	0.705
Organization's trading partners share business knowledge of core business processes with your organization	0.590
Organization and its trading partners exchange information that helps establishment of business planning	0.810
Organization and its trading partners keep each other informed about events or changes that may affect the other partners	0.743
Information quality (IQ)	
Information exchange between organization and its trading partners is timely	0.819
Information exchange between organization and its trading partners is accurate	0.855
Information exchange between organization and its trading partners is complete	0.796
Information exchange between organization and its trading partners is adequate	0.877
Information exchange between organization and its trading partners is reliable	0.840
Postponement (POS)	
Organization's products are designed for modular assembly	0.929
Organization delays final product assembly activities until customer orders have actually been received	0.930
Organization delays final product assembly activities until the last possible position (or nearest to customer) in the supply chain	0.383
Agreed vision and goals (VIGOAL)	
Supply chain members have common, agreed goals for supply chain management	0.711
Supply chain members are actively involved in standardizing supply chain management practices and operations	0.887
Supply chain members clearly define roles and responsibilities of each other's cooperatively	0.908
Know which supply chain members are responsible for what activity within the supply chain	0.772
Risk and reward sharing (RR)	
Supply chain members share risks and rewards	0.869
Supply chain members share research and development costs and results with each other	0.880
Supply chain members help each other financial capital investment	0.739

(*continued*)

Table II.
Factor analysis of supply chain practices constructs

Construct and items	Factor loading
Supply chain integration (SCI)	
Firms in our supply chain establish more frequent contact with each other	0.762
Firms in our supply chain create a compatible communication and information system	0.862
Our firm extends its supply chain beyond its customers/suppliers	0.844
Our firm participates in the marketing efforts of its customers	0.755
Supply chain performance (SCP)	
More accurate costing	0.882
Increase in coordination between departments	0.927
Increase in coordination with suppliers	0.926
Increase in coordination with customers	0.859
Increase in sales	0.957

Table II.

Reliability, a measurement consistency, was assessed by calculating Cronbach's α, a commonly used measure of reliability. Reliability is demonstrated when the items measuring a single construct are highly correlated and when the α-level is relatively high. As indicated in Table III, the α-values are all above 0.7 and deemed acceptable for social science research (Nunnally, 1978).

3.4 Techniques of analysis and robustness check

The data were processed in two stages. In the first stage, descriptive statistical analysis was performed to identify the characteristics of the sample firms and their level of SCMPs, SCI and SCP. The second stage involved testing the research hypotheses based on the procedure established by Baron and Kenny (1986). SCI is considered a mediator to the extent that it carries the influences of SCMPs to SCP. In testing the mediating effect, the procedure established in Baron and Kenny (1986) is followed. The procedure requires running simple formal heuristic analysis. In this aspect several equations are estimated and certain criteria needs to be satisfied to testing the mediating effects. The approach involves estimating the several equations that are presented diagrammatically in Figure 2. Panel A shows the total effect of the independent variable on the dependent variable and in our case the effect of SCMPs on SCP. Panel B shows the indirect effect of SCMPs on SCP mediated by SCI. In order to test the mediating effects of SCI, the following criteria need to be satisfied. First, the paths *c*, *a* and *b* need to be statistically significant which means the coefficient must be statistically different from 0. Once this is established, the next stage of analysis is to

Variables	Dimensions	Number of items	Cronbach's α
Supply chain management practices	Strategic supplier partnering	6	0.891
	Customer relationship	4	0.786
	Information sharing	5	0.788
	Information quality	5	0.891
	Postponement	2	0.889
	Agreed vision and goals	4	0.761
	Risk and reward sharing	3	0.765
Supply chain integration		4	0.828
Supply chain performance		5	0.947

Table III.
Reliability analysis

consider the effect of SCMPs on SCP with the inclusion of SCI, path c'. If the estimated coefficient of SCMPs decreases to 0 with the inclusion of SCI than there is a perfect mediating effect whereas if the coefficient decreases by a non-trivial amount, but not to 0, than partial mediation is concluded.

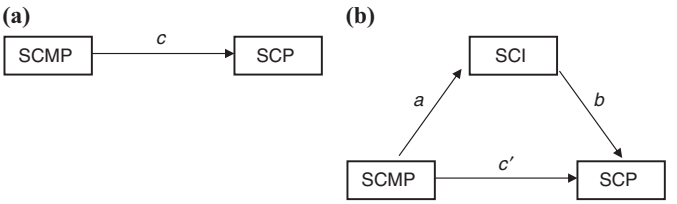
In addition to the above, Sobel (1982) provides a procedure to directly test the indirect effect. This is established by conducting the Sobel test by comparing the strength of the indirect effect of SCMPs on SCP and testing the null hypothesis whether the strength equals to 0. In other words, Sobel test involves forming a product term by multiplying the coefficient of paths a and b ($a \times b$) and statistically testing it using a normal distribution. This allows us to formally test the mediation effect of SCI apart from the just satisfying the requirements stated by Baron and Kenny (1986) for the mediating effects to occur. Sobel's test has been regarded to have a greater statistical power than other formal test. In fact, Sobel's test will avoid some of the shortcoming[3] due to the simplicity in establishing and testing a series of regression to test the mediating effects suggested by Baron and Kenny (1986).

Nevertheless, Preacher and Hayes (2004) highlighted the shortcomings of the Sobel's test and proposed the bootstrapping approach for more accurate results in testing the mediating effects. Sobel's test requires a large sample size and the critical values for the formal test ($a \times b = 0$) assumed to be normally distributed. Preacher and Hayes (2004) argued that in a small sample study, such as ours, the results of the Sobel's test may be misleading. In this case, Preacher and Hayes (2004) suggested the use of a non-parametric bootstrapping procedure. In this paper, we used a series of test, namely, Baron and Kenny's approach, Sobel test and bootstrapping approach to confirm the robustness of our results.

4. Results

The correlation matrix describes the association between the variables as well as reveals the strength of association of the seven dimensions of the SCMPs on SCI and performance. Table IV also shows that all the seven SCMPs dimensions are significantly positively associated with the mediating variable (SCI) and dependent variable (SCP). Mean scores indicates the level of the SCMPs in the electronics firms in Malaysia. It is observed that relatively information quality (5.85), information sharing (5.76) and customer relation management (5.67) are highly practiced by the electronics firms compared to other SCMPs.

Table V shows the results of direct and total effect of the SCMPs representing the path illustrated in Figure 2. Based on Barron and Kenny criteria the mediating effect of the individual dimensions of the SCMPs can be assessed. Information quality,



Notes: (a) Panel A: direct effects of SCMP on SCP; (b) Panel B: indirect effects of SCMP on SCP through SCI

Figure 2.
Total and indirect effects of supply chain management practices and supply chain performance

agreed vision and goals as well as postponement strategies were found to be fully mediated by SCI in extracting its influence on SCP. The coefficient of information quality (0.0127, $p = 0.8137$), agreed vision and goals (0.0772, $p = 0.1188$) as well as postponement strategies (0.0254, $p = 0.5094$) are significantly reduced and becomes statistically insignificant when controlled for SCI. Empirical evidence shows that other dimensions of SCMPs, namely, supply strategic partnership (0.1251, $p = 0.0096$), customer relation management (0.1856, $p = 0.0007$) and information sharing (0.1368, $p = 0.0243$) to be partially mediated by SCI. Although the coefficient values are reduced after controlling for the mediating effect, it is still significant at 5 percent. Risk and reward sharing is found to have no effect on SCI and performance. As a whole three of the SCMPs were found to be fully mediated while three others were found to be partially mediated by SCI.

A formal test were conducted to reconfirm the above results. Table VI shows the results of Sobel test and bootstrapping approach. The Sobel test results reconfirm the earlier observation that there is a mediating effects (either full or partial) for all the SCMPs (SSP; $z = 8.93$, CRM; $z = 5.22$; IS; $z = 7.726$; IQ; $z = 8.437$, VIGOAL; $z = 4.1105$; and POS; $z = 7.1245$) except for risk and reward sharing ($z = 1.4904$, $p = 0.136$). The bootstrapping results also supports similar results. For instance, bootstrapping output shows that risk and reward sharing effect is insignificant given that 0 lies between the critical values of −0.0463 and 0.2750 at 95 percent confidence level. For other variables, because 0 is not in the 95 percent confidence interval, we can conclude that the indirect effect is significantly different from 0 at $p < 0.05$.

The results provide some insight and support for the model in this study. The positive effects of SCMPs and SCI on SCP are supported empirically. Therefore, this result provides a confirmation of previous research studies; that firms which have strong implementation of SCMPs are likely to have a higher level of SCI (Kim, 2006; Tan *et al.*, 1999) and enhanced SCP (Koh *et al.*, 2007; Lee *et al.*, 2007; Lockamy and McCormack, 2004). This result could be reasoned in two folds. First, most supplier in the electronics manufacturing firms are encouraged to participate in the Supplier Partnering and Relationship Management provided by the focal manufacturing firms like original equipment manufacturer and original brand manufacturer. This partnering and participation process will enhance the supplier integration and supplier-related quality and lead time performance. In addition, for firms emphasizing on the information quality and sharing, through Collaborative, Planning, Forecasting and Replenishment system, could establish strong relationship across the upstream value chain and the downstream value chain for better SCI.

Table IV.
Descriptive statistics and person correlations analysis

	Mean	SD	SSP	CRM	IS	IQ	VIGOAL	RR	POS	SCI
SSP	4.930	1.086								
CRM	5.678	0.769	0.381**							
IS	5.764	0.786	0.445**	0.520**						
IQ	5.851	0.931	0.558**	0.356**	0.545**					
VIGOAL	5.261	0.839	0.301**	0.516**	0.396**	0.235**				
RR	5.220	0.949	0.132	0.175*	0.064	0.081	0.002			
POS	4.910	1.209	0.716**	0.436**	0.381**	0.473**	0.303**	0.081		
SCI	5.295	0.864	0.668**	0.401**	0.573**	0.616**	0.321**	0.120	0.529**	
SCP	5.511	0.996	0.658**	0.470**	0.572**	0.544**	0.338**	0.097	0.484**	0.872**

Note: *,**Correlation is significant at the 0.05 and 0.01 levels, respectively (2-tailed)

	Path	Coefficient	*t*-value	Sig.
Supply strategic partnership				
SSP→SCP	*c*	0.6035	10.84	0.0000
SSP→SCI	*a*	0.5311	11.13	0.0000
SCI→SCP	*b*	0.9008	15.018	0.0000
SSP→SCP/SCI	*c′*	0.1251	2.623	0.0096
Customer relation management				
CRM→SCP	*c*	0.6082	6.5999	0.0000
CRM→SCI	*a*	0.4498	5.4121	0.0000
SCI→SCP	*b*	0.9396	19.583	0.0000
CRM→SCP/SCI	*c′*	0.1856	3.4445	0.0007
Information sharing				
IS→SCP	*c*	0.7252	8.6627	0.0000
IS→SCI	*a*	0.6296	8.6813	0.0000
SCI→SCP	*b*	0.9344	17.058	0.0000
IS→SCP/SCI	*c′*	0.1368	2.2742	0.0243
Information quality				
IQ→SCP	*c*	0.5819	8.0503	0.0000
IQ→SCI	*a*	0.5708	9.6949	0.0000
SCI→SCP	*b*	0.9974	17.225	0.0000
IQ→SCP/SCI	*c′*	0.0127	0.2361	0.8137
VIGOAL				
VIGOAL→SCP	*c*	0.4013	4.4554	0.0000
VIGOAL→SCI	*a*	0.3301	4.2003	0.0000
SCI→SCP	*b*	0.9818	20.540	0.0000
VIGOAL→SCP/SCI	*c′*	0.0772	1.5687	0.1188
Risk				
RR→SCP	*c*	0.1019	1.2107	0.2279
RR→SCI	*a*	0.1089	1.4954	0.1369
SCI→SCP	*b*	1.0068	21.9060	0.0000
RR→SCP/SCI	*c′*	0.0077	0.1842	0.8541
Postponement				
POS→SCP	*c*	0.3987	6.8580	0.0000
POS→SCI	*a*	0.3782	7.7405	0.0000
SCI→SCP	*b*	0.9870	18.3771	0.0000
POS→SCP/SCI	*c′*	0.0254	0.6613	0.5094

Table V.
Direct and total effect

5. Theoretical and managerial implications

The theoretical literature on supply chain management suggest direct causal link between SCMPs and performance. And, evidence of this link unsurprisingly promotes policy makers and managers to devise policy instruments and managerial implications. As a result, greater attention is attached on the SCMPs ignoring the role of SCI. In this study, a number of theoretical contributions have been made. First, this study has departed from two disjointed literatures (e.g. influence of SCMPs and performance as well as influence of SCI and performance) by integrating the framework of analysis and empirically showing the influence of SCMPs on SCP through the mediating effects of SCI. The theoretically integrated perspective provides a better framework for understanding the complex relationship between SCMPs, SCI and SCP. In other words,

Table VI.
Results of Sobel test on indirect effect ($b \times a$) using normal distribution and bootstrapping approach

Sobel test	Value ($b \times a$)	SE	LL95CI	UL95CI	Z	Sig.
SSP	0.4784	0.0536	0.3734	0.5834	8.9311	0.000
CRM	0.4226	0.0809	0.2640	0.5813	5.2210	0.000
IS	0.5884	0.0761	0.4391	0.7376	7.7265	0.000
IQ	0.5693	0.0675	0.4370	0.7015	8.4379	0.000
VIGOAL	0.3241	0.0788	0.1695	0.4786	4.1105	0.000
RISK	0.1096	0.0736	−0.2538	0.2538	1.4904	0.136
POS	0.3733	0.0524	0.2706	0.4760	7.1245	0.000
Bootstrap	Value ($b \times a$)	Mean	SE	LL95CI	UL95CI	
SSP	0.4784	0.4764	0.0532	0.3752	0.5853	
CRM	0.4226	0.4213	0.0807	0.2613	0.5802	
IS	0.5884	0.5861	0.0794	0.4310	0.7457	
IQ	0.5693	0.5664	0.0698	0.4323	0.7106	
VIGOAL	0.3241	0.3213	0.0934	0.1317	0.4975	
RISK	0.1096	0.1118	0.0821	−0.0463	0.2750	
POS	0.3733	0.3740	0.0577	0.2621	0.4910	

Note: Number of bootstrap resample is 5,000

the roles of SCMPs are revealed to understand the possible means to appropriate SCP. Second, we make further contribution by revealing how each dimension of SCMPs are mediated by SCI, either fully or partially, in influencing SCP. It suggests that SCI do not have the same mediating effects on all dimensions of SCMPs in influencing SCP. The decomposition of the SCMPs itself is important for managers and researchers to understand. Therefore, managers and researchers should be cautioned in assuming that SCI is beneficial in the same manner to explain the relationship between SCMPs and SCP. For instance, those SCMPs that SCI mediates partially to influence SCP exhibits two part impact. First, the direct impact on SCP and second, indirect effects through SCI on performance. In contrast, for those dimensions of SCMPs that are fully mediated, the evidence cautions that with the absence of SCI, SCMPs will have small or no impact on SCP. This theoretically contribution is rare in the past literatures. This information is very crucial especially in the age of globalization where increasingly firms intensify SCI processes both internally and externally. Indeed, in the case of Malaysia, it is important given that integration between MNCs and SMEs will further enhance the competitiveness of the industry as a whole. MNCs also requires the support of the SMEs in facilitating their production through outsourcing activities.

Managerial implications are twofold. The findings suggest that managers can take advantage their existing SCMPs to stimulate SCI and consequently influence their firm performance level. In addition, managers, now, are able to identify which SCMPs will likely to benefit more in enhancing SCI. Greater benefits are likely to be more if managers improve practices in areas such as information quality, agreed vision and goals and postponement strategies while risk and reward sharing practices are unlikely to promote SCI. Those partially mediated practices should also be considered given the fact that they do extract some influence on SCI. The current mean scores of SCI is still relatively low in the industry and, as such, managers should promote greater information quality, agreed vision and goals and postponement strategies to enhance SCI and performance.

If managers are considering investment in supply chain management, obviously managers should invest in both SCMPs and SCI to extract the most benefit for SCP. As such investment decision should not be an independent activity considering only

practices or integration since SCI mediates the relationship between SCMPs and SCP. It's imperative that managers highlight this to the top management for any budget allocation for the purpose of investment in supply chain management activities.

Similarly, this study was able to develop an empirical supply chain practices and integration model for improving the performance of manufacturing firms serving business and retail customers. Supply chain managers in the manufacturing firm could use these key supply chain practices and transform them into industrial critical success factors. As such, these critical success factors will be identified as the key result area to formulate key performance indicator to measure the effectiveness and efficiency of the organizational resources and supply chain as a whole. Further, managers will also have several options in selecting the right SCMPs ranging from upstream, downstream, internal and across supply chain which could better the performance of SCMPs of the electronics industry in Malaysia.

6. Limitations

This study has its own limitations. Among them include the selective case study on electronics firms. With respect to this, evidence is limited to only one sector and generalization may not be possible especially when accounting for the applicability of the findings in other sectors. However, as explained earlier, single sector case study allows the study to avoid heterogenity in terms of controlling for industrial characteristics, which is diverse, and provide greater control over the sample and estimation. Indeed, since the mediating model has been verified, future studies can expand their scope to test the framework suggested in this study within the context of other sectorial setting. Another limitation, however, is that there might be a cause for possible response bias as data were collected from single respondents in an organization. Caution should, therefore, be exercised when interpreting the results. Future research should endeavor to collect data from multiple members within the firm. Furthermore, since this study reports questionnaire survey at one point in time, it might not show trends or changes. Therefore, further research could enhance the generalizability of the present results. Further research could also be performed to expand research scope to investigate the comparative implementation situation between different industries in terms of types of business operations, ownership and firm sizes. Other than this, future research can also be undertaken on studying the synergies between total quality management practices and knowledge management as well as measuring how practices of other disciplines in combination with SCMPs could affect SCI and SCP.

7. Conclusion

In conclusion, as a whole, findings in this study indicate that SCMPs have significant effects on SCI. The finding is also in accordance with previous studies that found the significant role of SCMPs in achieving SCI (Kim, 2006; Levy *et al.*, 1995; Li *et al.*, 2009; Power, 2005). These variables are, in fact, been mediated by SCI in influencing SCP. It was found that SCI plays an important role in enhancing SCP. Thus, enhanced level of SCI is important in improving the SCP. Furthermore, SCI was also found to partially mediate the relationship of SCMPs (via information sharing and information quality dimension) and SCP. Overall, the findings show that supplier strategic partnering is the most important dimension of the SCMPs in influencing SCI and SCP. This finding is consistent with other studies that highlighted the significant role of SSP in achieving SCP (Hamister, 2012; Roloff *et al.*, 2015; Qrunfleh and Tarafdar, 2013).

This paper provides empirical justification for a framework that identifies seven dimensions of SCMPs while describing the relationship between SCMPs, SCI and SCP within the context of electronics manufacturing in Malaysia. Data for the study were collected from a sample of 156 electronics manufacturing firms and the research framework was tested for the mediating effect of SCI. In the long term, the success of electronics manufacturing firms in Malaysia is heavily dependent on the effectiveness of their strategic supply chain factors such as supplier strategic partnering, information sharing, information quality, postponement and SCI. As such, this study concludes that, the entire value chain along the upstream and internal process of the supply chain has to be successfully effective. The results are consistent with the findings by other researchers (Chandra and Kumar, 2000).

The major contribution of the present study is that it simultaneously examines the mediating effect of SCI and its impact on the relationship between SCMPs and SCP. Moreover, this study is one of the first, to address the above theoretical gap. This study offers a number of managerial implications. First, by identifying SCMPs dimensions and its ability to improve performance of electronic manufacturing firms; it provides supply chain management managers with an impeccable formula for evaluating the effectiveness of the SCMPs. Second, the analysis of the relationship between SCMPs, SCI and SCP simultaneously indicates that SCMPs might directly or indirectly influence SCP. Third, the findings of this study tend to support the view that the implementation of SCMPs has a significant impact on the effectiveness of the supply chain and a direct impact on the performance of electronics manufacturing firms in an emerging country as in the context of, Malaysia. Fourth, managers can optimize the firm's operational objective in tandem with the right SCI strategy and subsequently boost the firm's performance and organizational based SCP. Researchers can use the findings herein to generate ideas for future studies, and top managers can glean important knowledge about how effective SCMPs and SCI impacts SCP.

Notes

1. Kim (2006, 2009) examined the links between the three but yet the construct of supply chain practices is still narrowly defined. In this study, we include seven different dimensions to capture the supply chain practices. Indeed, we examined the effects on supply chain performance and not on firm performance.
2. Our earlier study (Veera *et al.*, 2011) used different sample size to test the direct influence of supply chain management practices on supply chain performance. This study is an extension of our earlier paper and uses larger sample as well as complete framework to examine the mediating role of supply chain integration.
3. See Holmbeck (2002) and Preacher and Hayes (2004) how the approach can lead researchers to incorrectly conclude the mediating effects due to Types I and II errors. Indeed, MacKinnon *et al.* (2002) argued that Baron and Kenny approach also suffers from low statistical power in most situations.

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