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# The Impact of Supply Chain Integration on Operational Capability in Malaysian Manufacturers

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**Abstract**

This study aims to explore the effect of supply chain integration (SCI) on operational capability. Using data collected from 201 Malaysian small- and medium-sized manufacturers (SMMs) and rigorous structural equation modeling methods, a total of one main effect and four sub-effects were hypothesized and tested. All the proposed hypotheses were found to be significant, suggesting positive relationships between SCI and operational capability, as well as between sub-constructs of SCI and operational capability. Overall, the findings are particularly important for SMMs owing to resource paucity and the need to draw upon SCI in order to ensure a sustainable operational capability. Recommendations for how to improve operational capability are provided accordingly.


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*Keywords*: supply chain integration; operational capability; small- and medium-sized manufacturers

## 1. Introduction

Supply chain management (SCM) is a holistic approach to demand, sourcing and procurement, production and logistics process management (Chow et al., 2008; Chopra and Meindl, 2010). It is a network consisting of all parties involved (e.g. manufacturer, supplier, retailer, customer, etc), both downstream and upstream, directly or indirectly, for manufacturing and delivering a product or service to the end customers (Mentzer et al., 2001). The network incorporates various sub-systems, activities, relationships and operations (Chandra and Kumar, 2000) and is

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connected through the forward and reverse flow of information, materials, services and finances (Stock and Boyer, 2009) in order to enhance the organizational and overall supply chain performance, and likewise to bring high value to customer requests in terms of quality, cost, speed and flexibility (Chow et al., 2008; Ketchen et al., 2008).

An integrated supply chain framework is needed to tie the whole network together in order to reduce perennial supply chain challenges such as functional silos, poor transparency of knowledge and information and the inadequate formation of appropriate customer and supplier relationships (Storey et al., 2006). As such, supply chain integration (SCI) plays a pivotal role in improving organizational performance (Richey et al., 2009; Boon-itt and Wong, 2011). Numerous SCM practices are used to effectively integrate supply and demand to improve the management of a supply chain (Li et al., 2005; Wong et al., 2005; Koh et al., 2007). SCI requires a collaborative effort among suppliers, cross-functional departments and customers that are linked and coordinated by the flow of processes and information (Boon-itt and Wong, 2011).

Firms need capability from overall operations, including cooperation and reconfiguration (Flynn et al., 2010; Wu et al., 2010). The capabilities that enable firms to cope with uncertainty and gain a competitive advantage through supply chain responsiveness are imperative. In fact, the operation encompasses all facets of firm's activities directed toward producing a product or rendering a service. The operational capability allows the respective manufacturing systems to become highly responsive in terms of equipment, material and labour (Wu et al., 2010). Operational capabilities are "firm-specific sets of skills, processes, and routines, developed within the operations management system that are regularly used in solving its problems through configuring its operational resources" (Wu et al., 2010, p. 726). The operational cooperation (OC) is the ability to coordinate all related parties to work together as a whole to exchange information and develop a shared definition of the solution needed (Flynn and Flynn, 1999). In addition, the operational reconfiguration (OR) is about reshaping (investing and divesting) operations resources in order to catch up with environmental changes (Wu et al., 2010).

SCM and operational capability continue to play critical roles in influencing a firm's ability to compete in the market. Studies are increasingly looking across the supply chain, beyond their encompassing concept, to establish the link between operations and SCM (Robb et al., 2008; Chen and Kim, 2007; Zhang and Dhaliwal, 2009; Oliva and Watson, 2011), with the aim of creating a seamless flow of goods/services and information from suppliers and operations to the customers. However, to the best of the authors' knowledge, the linkages between SCI and operational capability have not yet been addressed explicitly and modeled collectively. Indeed, previous studies have found there is a link between SCM practices and firm performance (Tan, 2002; Min and Mentzer, 2004; Li et al., 2005; Chow *e*t al., 2008; Chong et al., 2011; Cook et al., 2011). For example, Li et al. (2005) suggested an overarching framework to address downstream, internal and upstream sides of the supply chain. They found that organizations achieve better performance when they embrace a higher level of SCM practice. However, this framework is not applicable in the context of small- and medium-sized manufacturers (SMMs), as there are inconsistent results about the direct relationship between SCM practices and business performance in large companies and SMMs. SCM practices in SMMs are more relevant to operational performance and have an indirect relationship between SCM practices and firm performance. As indicated by Koh et al. (2007), the implementation of SCM practices has a significant impact on the operational efficiency of small manufacturers in developing countries. This implies that the actual contribution of SCM practices to firm performance may not be direct; it is probably mediated by a number of competencies and interrelated objectives (Tracey et al., 2004). In view of scant research efforts investigating the link between SCI and operational capability for SMMs in Malaysia, this study aims to fill the research gap.

In Malaysia, small and medium enterprises (SMEs) constitute 97.3% of businesses and have the potential to be a powerful engine for growth and innovation (SME Annual Report, 2011/12). In addition, SMEs contributed 32.5% of the gross domestic product (GDP) and 57.3% of total employment in 2011, likewise recorded a relatively strong GDP growth (6.8%) compared with the overall economy (5.1%). Though SMMs accounted for 5.9% of total SMEs establishment and contributed 7.9% to GDP, however, SMMs achieved the highest growth (7.6%), followed by both the agriculture and service sectors (both 6.4%) (SME Annual Report, 2011/12). As SMMs are important growth engines, there is great potential for Malaysian SMMs to develop into the most significant domestic source of growth.

## 2. Conceptual Model

The hypothesized model linking the relationship between SCI and operational capability is depicted in Figure 1. The model is mainly grounded within the resource-based view (RBV) and network perspective theory to explain firm-specific and relational capabilities. Two research questions surround the theoretical framework for this study. First, which kinds of SCI practices do SMMs need? Following the studies of Tracey et al. (2004), Li et al. (2006) and Koh et al. (2007), the researchers argue that supplier management (SM), customer relationships (CR), manufacturing participation in strategy (MPS), and inventory control (IC) are important kinds of SCI practices needed by SMMs to achieve enhanced operational capability. Second, which specific kinds of operational capability are being practiced by SMMs? Researchers (Flynn et al., 2010; Wu et al., 2010) have recommended operational capabilities, such as cooperation and reconfiguration, as potential sources of competitive advantage.

The proposed theoretical construct of SCI practices include SM, CR, MPS and IC. Operation capabilities consist of OC and OR. Finally, it is imperative to note that the proposed constructs are not a complete set of measurement scale due to the entire of SCI practices and operational capabilities can not be encompassed in just a single study.

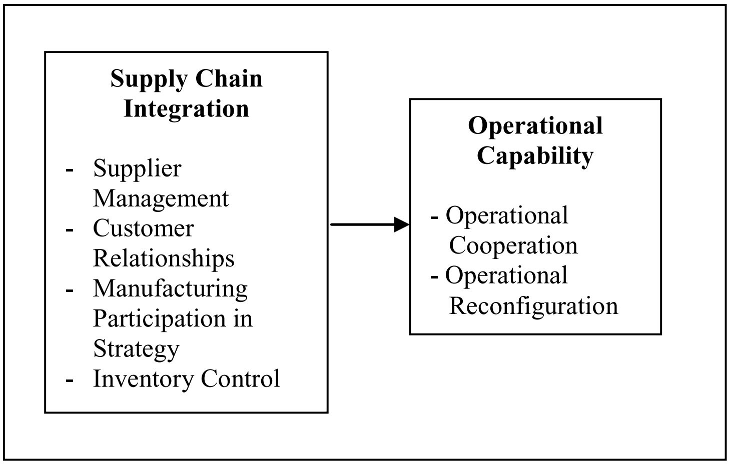


Fig. 1. Proposed conceptual model.

## 3. Hypothesis Development

The integrated supply chain from a horizontal perspective (supplier and customer integration) has led to a higher level of operational competency in terms of logistics services, such as the ability to offer services including vendor managed inventory and just-in-time, to make products easily available to customers and to adapt the distribution network quickly to meet the demand (Halley and Beaulieu, 2009). Other operational competencies include cost (the ability to control and reduce cost), design (the ability to make product design changes and introduce new products quickly) and delivery (the ability to offer fast delivery and respect delivery promises). Basically, this study is consistent with many researchers' findings (e.g., Frohlich and Westbrook, 2001; Li et al., 2006) that supply chain practices may affect competitive advantage directly. The relationship between SCI and operational capability is grounded on network perspective theory. The network perspective focuses on the inter-organizational interactions of several parties. Through the coordination of efforts and strategies, a network can enhance the resources, competencies and capabilities of individual firms (Lavassani et al., 2008). Enterprises' competitive capability can be promoted if there is internal decision making and activity between firms and their external partners (Li and Wang, 2007). Furthermore, RBV suggests that operational capability is a non-substitutable, inimitable, path-dependent capability that a firm develops over time to achieve sustainable competitive advantage (Schroeder et al., 2002).

Close collaborative linkages with suppliers are essential for the SCM implementation of the firm (Min and Mentzer, 2004; Tracey et al., 2004; Li et al., 2005; Ellegaard, 2006; Koh et al., 2007; Chow et al., 2008; Robb et al., 2008). Tumala et al. (2006) pointed out that a strategic long-term relationship positively affects all of a firm's spheres of activities. Additionally, Lee and Billington (1992) reported that supplier integration could offer a new avenue to improve internal operational competencies. The strategic task of a supply relationship positively affects the capability of profit making and the integral supply chain, as well as the manufacturer's competitive capability (Locke and Romis, 2007).

Effective customer integration ensures continued growth and competitiveness in the market in terms of value creation (Storey et al., 2005; Reichhart and Holweg, 2007). Value-creation strategies such as building a close relationship with customers, in turn, build on the operational capability of the firm. Tan (2002) and Li et al. (2005) accentuated that the relationship between an organization and its customers is a way to achieve competitive advantage and business performance. Wu et al. (2010) illustrated study evidence that customer relationship management is closely related to operational capability in terms of cooperation.

In addition, the manufacturing function of a company may play the role of a competitive weapon or a corporate milestone (Skinner, 1969). Manufacturing is the basis of organizational competitive advantage and world-class manufacturing to drive business strategy in exceeding customer expectations (Hayes and Wheelwright, 1984). Eisenhardt and Schoonhoven (1990) identified that some manufacturing participation practices affect firms' operations. Similarly, various forms of collaborative inventory management can reduce operating costs and improve profitability (Sari, 2007). An integrated supply chain from the vertical and horizontal perspectives has led to a higher level of business performance.

The above SCI practices interact with each other and can hold an organization together for operational capabilities; they have been found to lead significantly to operational performance (Lee and Amaral, 2002; DeLone and McLean, 2003; Koh et al., 2007; Halley and Beaulieu, 2009; Zhang and Dhaliwal, 2009), which influence the abilities of a firm to compete in the market. Based on the empirical evidence, SCI is positively related to operational performance. This means that supply chain practices are associated with the development of operational capabilities for better operational performance and ultimately for achieving superior firm performance. The discussion develops the basis of the following hypotheses:

H1: SCI is positively related to operational capability.
H1a: SM is positively related to operational capability.
H1b: CR is positively related to operational capability.
H1c: MPS is positively related to operational capability.
H1d: IC is positively related to operational capability.

## 4. Sample, Data Collection and Measurements

A questionnaire was the main instrument of data collection for this study. The questionnaire was mailed to potential respondents through various sources: the "FMM directory of Malaysian Manufacturers 2012," the list of companies from the SME Corporation Malaysia official website, and networking. The questionnaire was mailed and hand delivered to the firms from May 2012 to October 2012 and the title of the targeted respondent sought was primarily Chief Executive Officer (CEO), Managing Director, owner of the firm or senior officer/executive in charge of supply chain practices in the firm. The results indicated that majority of the respondents were senior management from the firms. The profile of the respondents (SMMs) is shown in Table 1. In general, a higher number of respondents worked for machinery, equipment and instruments (28.3%) and chemical, petrochemical and polymer (22.9%) groups than the other groups. The final usable sample, including both the mail and hand delivery survey, was 201.

A non-response bias was conducted to compare the responses of early and late waves of returned surveys based on that late-respondents are considered as a sample of non-respondents and they are theorized to have similarities with non-respondents. The responses were also split as mail and hand delivery surveys; early and late respondents within the mail survey; and early and late respondents within the hand delivery survey. The non-response bias compared responders and non-responders, and mail and hand delivery surveys according to demographic variables such as job title, company ownership, sub sector, year of company establishment and company size. Chi-square test yielded no statistically significant differences between early-respondents and late-respondents, mail and hand delivery surveys, early and late mail responses, and early and late hand delivery responses, concluding that non-response bias may not be a serious issue in this study.

Table 1. Profile of respondents

| Industry Group | Frequency | Percent (%) |
|---|---|---|
| Food Products & Beverages | 24 | 11.9 |
| Chemical, Petrochemical & Polymer | 46 | 22.9 |
| Metal & Other Non-Metallic Mineral Products | 35 | 17.4 |
| Machinery, Equipment & Instruments | 57 | 28.3 |
| Furniture & Wood-based Products | 19 | 9.5 |
| Others | 20 | 10.0 |

The indicators in the proposed questionnaire were based on the existing literature. In total, 19 questions were used to measure the construct of SCI: SM, CR, MPS and IC (Tracey et al., 2004; Li et al., 2006). The construct of OC was operationalized by indicators to reflect the extent to which firms emphasize information system and formal procedures to maintain healthy relationships with each other to diagnose/solve problems. The measurement items including the new and better practices adoption, resources reconfiguration and knowledge/competence development to respond to market changes were used to measure the OR. Responses to the questions were based on a 5-point Likert scale that ranged from 1 (strongly disagree) to 5 (strongly agree).

## 5. Data Analysis and Research Findings

Exploratory factor analysis (EFA) using principal component analysis with varimax rotation was used to assess construct validity of SCI and operational capability. The appropriateness of using factor analysis is further substantiated by Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) measures of sampling adequacy. The value for KMO measures of sampling adequacy should be greater than 0.7, and is inadequate if less than 0.5; Bartlett's test should be significant at a significance value of less than 0.05 (Leech et al., 2005). From the results, KMO values are well above the recommended acceptable level of 0.7; thus confirming that the collected data were worthy of factor analysis. Table 2 shows that the factor loadings on all six constructs exceed 0.45 (Hair et al., 1998), which exhibits sufficient validity for the measured items. In addition, A Cronbach's alpha value of 0.7 or more is an acceptable reliability coefficient (Nunnally, 1978). However, Hair et al. (1998) suggested that Cronbach alpha values from 0.6 to 0.7 are acceptable. All factors were acceptable and indicated evidence of reliability as the Cronbach's alpha values ranged from 0.68 to 0.92.

Structural equation modelling (SEM) was used to test the hypothesized full structural model. The model fit indices for the proposed model were found to be: $\chi^2/df = 2.632$, GFI = .968, AGFI = .915, RMSEA = .090, NFI = .946 and CFI = .965. The RMSEA value was .090 with a 90% confidence interval of .044 to .138, suggesting an adequate model fit. A cut-off criterion of 0.90 for these scores (GFI, AGFI, NFI, and CFI) is recommended to indicate evidence of a good fit. The RMSEA value between 0.08 and 0.10 provides a mediocre fit (MacCallum et al., 1996).

Table 2. Results of EFA.

| Component | SM | CR | MPS | IC | OC | OR |
|---|---|---|---|---|---|---|
| SM1 | .57 | | | | | |
| SM2 | .70 | | | | | |
| SM3 | .83 | | | | | |
| SM4 | .53 | | | | | |
| CR1 | | .72 | | | | |
| CR2 | | .73 | | | | |
| CR3 | | .73 | | | | |
| CR4 | | .70 | | | | |
| CR5 | | .61 | | | | |
| MPS1 | | | .68 | | | |
| MPS2 | | | .84 | | | |
| MPS3 | | | .83 | | | |
| IC1 | | | | .73 | | |
| IC2 | | | | .74 | | |
| IC3 | | | | .75 | | |
| IC4 | | | | .75 | | |
| IC5 | | | | .85 | | |
| IC6 | | | | .85 | | |
| IC7 | | | | .85 | | |
| OC1 | | | | | .73 | |
| OC2 | | | | | .86 | |
| OC3 | | | | | .78 | |
| OR1 | | | | | | .78 |
| OR2 | | | | | | .92 |
| OR3 | | | | | | .88 |
| α | .68 | .81 | .85 | .92 | .74 | .87 |
| Eigen value | 2.19 | 2.95 | 2.25 | 4.82 | 2.04 | 2.34 |
| Variance Explained (%) | 11.5 | 15.5 | 11.8 | 25.4 | 34.0 | 39.0 |

As shown in Figure 2, the proposed structural model, H1 positively links SCI with operational capability and it was found to be significant ($b$ = .93; $t$ = 7.779; $p < .01$). Of the individual SCI practices, CR ($b$ = .72; $p < .01$) and MPS ($b$ = .71; $p < .01$) featured as the most important SCI practices, while IC ($b$ = .70; $p < .01$) and SM ($b$ = .60; $p < .01$) were relatively less important SCI practices. As for operational capability, OC ($b$ = .70; $p < .01$) was found to be the leading operational capability compared with the OR ($b$ = .68; $p < .01$). Taken together, these results provide empirical support to H1 that SCI practices are positively related to operational capability.

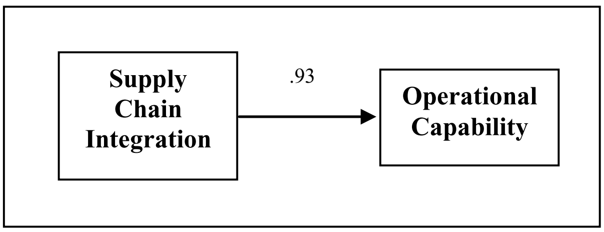


Fig. 2. Proposed structural model.

Sub-constructs of SCI were further tested for their impacts on operational capability. SEM was carried out for the hypothetical data on (H1a) SM → operational capability; (H1b) CR → operational capability; (H1c) MPS → operational capability; and (H1d) IC → operational capability. The model fit statistics were reasonable and all the paths were found to be positive and statistically significant at $p < .01$. The results provide adequate support to H1a to H1d, showing that the sub-constructs of SCI are positively related to operational capability, as shown in Table 3. The findings show that in terms of the prioritization of SCI practices among Malaysian SMMs, the ranking is consistent with the results found in the previous discussion of hypothesized full structural model.

Table 3. Results for sub-constructs hypotheses.

| **Hypothesis** | **Relationship** | ***b*** |
|---|---|---|
| H1 | SCI → Operational Capability | .93 |
| H1a | SM → Operational Capability | .50 |
| H1b | CR → Operational Capability | .72 |
| H1c | MPS → Operational Capability | .72 |
| H1d | IC → Operational Capability | .71 |

## 6. Implications and Recommendations

The research findings of this study have several implications for academics and others involved in theory building. Firstly, this study extends previous supply chain practice frameworks in Western countries by considering different key dimensions of SCI practices in Malaysian manufacturing SMMs. The research data strongly argue that for strategic SCI to be successful, scholars must not focus on one particular inhibitor, but rather consider customer integration, supplier integration and internal functions in combination. Secondly, this study is one of the first papers to examine the relationship between SCI and operational capabilities using the highly rigorous method of SEM. SCI practices have a positive impact on operational capabilities. The presence of the relationship stresses the role of learning in implementing supply chain practices over time. The learning process can help firms to develop capabilities that are hard to imitate and create value.

In addition to the theoretical implications for academics, the findings of this study may also have implications for managers and practitioners, especially for those in SMMs. First, SMMs face difficulties in selecting suitable and effective SCM concepts and methods (Li et al., 2006). The study found evidence of some highly varied and progressive SCI practices amongst SMMs. Therefore, it provides managers with a useful tool to evaluate current supply chain practices and recommends simple but effective and efficient practices to perform vitally important supply chain functions aimed at enhancing operational capabilities.

Second, the results of the study support the claim that the execution of SCI positively affects the operational capabilities of SMMs in a developing country. Therefore, managers can easily gain a general overview of the implementation of suitable SCI practices for enhanced operational capabilities. The results suggest that OC is the leading capability. From the findings, a company can invest only in the capability to develop a competitive differentiation strategy for sustainable performance, rather than investing in a series of practices and capabilities that may incur more costs. Accordingly, managers must not only develop unique capabilities internal to the firm, but they must recognise the combined effects of SCI practices that can generate a total impact on operational capabilities.

This study contributes to both practical and theoretical knowledge, but the results contain several potential limitations. First, the sample population of this study was narrowly focused on Malaysian SMMs in several locations and may not be a true representation of all Malaysian manufacturers. It is of great importance to include more manufacturing companies in future research. The results would be considerably clearer if representing the full picture of Malaysia's manufacturing industry. Second, this study is parsimonious in that the data were collected from a single informant in each SMMs. Future research should collect survey information from multiple respondents from each participating firm using the instrument developed in this study to enhance the reliability of the research findings. Finally, SCM has evolved rapidly from being a one-dimensional subject with a narrow focus on logistics and the physical aspects of material flow into a multifaceted theory encompassing every effort involved in producing and delivering a final product from the supplier to the customer. Other factors within the domain of supply chain practices and operational capabilities are required for further exploration. Further research into these would contribute to the knowledge of supply chains and firm capabilities (especially concerning SMMs in the manufacturing industry) and the relationships among them.

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