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A comprehensive model for supply chain integration
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Abstract

Purpose – Extant research on supply chain integration defines integration in different ways, and mainly discusses a limited number of integration elements. The purpose of this paper is to develop a conceptual integration model which consists of comprehensive elements that are important to academic research and industrial practices.

Design/methodology/approach – Key literature survey with drawing threads of existing practices together for developing a systematic referential model and then verify the model with a real case.

Findings – Developed a model consisting of integration elements residing at the strategic, managerial, operational, and fundamental levels (bottom line). Based on the benefit alignment, the total integration requires supply chain partners to integrate resource flows (material, information, knowledge, and finance), processes and organization, planning and control activities and strategy.

Research limitations/implications – The research is based on secondary data and a case study illustration. Further empirical research is required.

Practical implications – The normative model can guide managers to integrate resources and activities in their efforts for an effective supply chain management. It supplements the Supply Chain Operations Reference Model developed by the Supply Chain Council with an interface description, which may guide the development of information systems for supply chain integration.

Originality/value – The comprehensive model provides a more inclusive and integrated perspective of supply chain integration. It is expected that the consensus of supply chain integration could be achievable based on this model. The conceptual framework will assist the researchers to determine integration variables of supply chain.

Keywords Logistics, Supply chain management

Paper type Conceptual paper

1. Introduction

The purpose of supply chain management is to integrate the activities of partnering firms and to create seamless supply chain (Towill, 1997), where territorial boundaries between partners are eliminated and all entities of the value chain become integral parts of an organization, in order to provide quality products and services and satisfy the demands of customers effectively and leverage competitive advantages together. Supply chain

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management is different from the management of a single enterprise, it is about exploiting business partners' core competencies and advanced resources to achieve organizational objectives and integrating independent enterprises into one group to maximize the benefits, reduce costs, and be adaptive to the changing business environment.

The integration of supply chain management systems has been the subject of significant debate and discussion during the last 20 years (Leuschner *et al.*, 2013; Power, 2005). The concept of supply chain management is primarily based on the integration of the activities of partnering firms. From a manufacturer's perspective, Flynn *et al.* (2010, p. 59) define supply chain integration as "the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organization processes". This definition emphasizes strategic collaboration and process integration (Flynn *et al.*, 2010). Whereas Lee (2000) stresses the flows of material, information, and finance in the network consisting of customers, suppliers, manufacturers, and distributors. Lee (2000) presents a three-dimension framework of integration: information, coordination, and organizational linkage. Leuschner *et al.* (2013) term supply chain integration as the scope and strength of linkages in supply chain processes across firms. These general conceptual discussions lack a clear hierarchical structure and corresponding implementation functional areas or departments. There is still a scarcity of well-grounded theoretical frameworks canvassing a complete set of elements that illustrate the reality of supply chain integration (Chen *et al.*, 2009).

Van der Vaart and Van Donk (2008) and Fabbe-Costes and Jahre (2007) have reviewed the literature on supply chain integration research and found that almost every author has his/her own understanding about supply chain integration. But there is little consistency in the basic definitions and contents of the constructs used in extant research as many of them have hardly built on previous work, and thus leading to little consensus on how to capture the essence of supply chain integration. A large list of seemingly different constructs and measurements could be drawn up from extant survey-based research (Leuschner *et al.*, 2013), nevertheless individual authors usually include only a limited number of items and components of supply chain integration (Van der Vaart and Van Donk, 2008). Academic research needs an extensively applicable framework which encompasses all basic factors of supply chain integration, so that it will benefit both researchers and practitioners.

Leading companies, such as Toyota, Honda, and Li and Fung, contribute many valuable cases (e.g. Lee, 2000; Liker and Choi, 2004; Magretta, 1998; Narayanan and Raman, 2004) which supplementarily provide the issues that are addressed in industries, although different companies place their emphases on different aspects and elements of integration. A top priority for researchers and practitioners should be to develop a normative model that can guide managers in their efforts to develop and manage their supply chains rather than following, testing and verifying business practices that have been in place for a decade (Lambert and Cooper, 2000). Nonetheless, such models and related studies are still rare in the literature. The well-known model that serves such purpose is the Supply Chain Operations Reference (SCOR) Model by the Supply Chain Council, which focuses on operational processes and performance evaluation. Till now SCOR Model has not modelled the interfaces between trading partners, so that its adoption and application is at best limited (Power, 2005).

In summary, there is still a limited understanding about the essence of supply chain integration and a lack of comprehensive framework for it. Therefore, this research aims to address this gap by developing a normative model with a suitable structure and comprehensive elements identified from supply chain integration literature and practices.

In order to develop the conceptual model of supply chain integration, we will draw the threads of existing research together to formulate a larger or more integrated perspective (Meredith *et al.*, 1989). The extant literature contains scattered elements that have been considered to fit into developing a model in this paper. The main objective of our paper is to identify the relevant issues of supply chain integration and incorporate them into a comprehensive and inclusive conceptual model in a systematic way.

This paper is organized as follows: Section 2 proposes supply chain integration model with detailed description of its elements. Data collected by the literature review and analysis has been used to develop the model. For making the description succinct and clear, each element is addressed separately with subheadings, though they are closely interrelated. In Section 3, issues regarding how to implement the supply chain integration model are briefly discussed. This is followed by an illustrative case (Section 4) to discuss the application of the model. Finally in Section 5, a discussion on the implications of the model and recommendations for further research are presented.

2. A comprehensive model for supply chain integration

Stevens (1989) suggests that companies should integrate internally first (internal integration), and then extend the integration to their supply chain partners (external integration). In this paper, we particularly focus on the external integration, which refers to the integration of a firm's activities with those of their customers and suppliers (Leuschner *et al.*, 2013; Stock *et al.*, 1998) to discuss the interconnectivity among those supply chain entities and required elements. However, it does not hinder the importance of internal integration as we consider it to be essential readiness for extending to external integration. The comprehensive model is actually a generic interface explanation beteen supplier and its customer, we will not distinguish the difference between upstream integration and downstream integration as Wang and Chan (2010).

The links between supply chain partners are analogous to computer network, which is defined as a collection of independent computers and devices that are connected by communication channels in order to share resources. Considered the urgency of the need for standards to allow formation of heterogeneous computer networks, in 1979, the International Standards Organization created a layered model called the Open Systems Interconnection (OSI) model to describe the defined layers in a network operating system (Zimmermann, 1980). It applies seven layers to describe the necessary integration processes in transmitting information among computers in a network environment. Since then, the OSI model has laid the foundation for software and hardware developments of computer networks and information communications. With a similar approach, this paper attempts to set up a reference model for supply chain integration.

By similar effort, Stevens (1989) has provided a three-level perspective for developing an integrated supply chain: strategic, tactical, and operational. The three-level structure is corresponding with enterprise hierarchy, so it is more feasible to be implemented. But the framework which has only explained concepts of the three levels briefly is too simple and generic, without details about the strategic, tactical, and operational integration. While subsequent literature places emphasis on the operational integration of processes and flows of material, information, and cash (Flynn *et al.*, 2010).

We propose a comprehensive model of supply chain integration as shown in Figure 1, which comprises strategic, managerial, operational, and fundamental levels. Each level consists of one or several integration elements. Each element that constitutes the framework is now described.

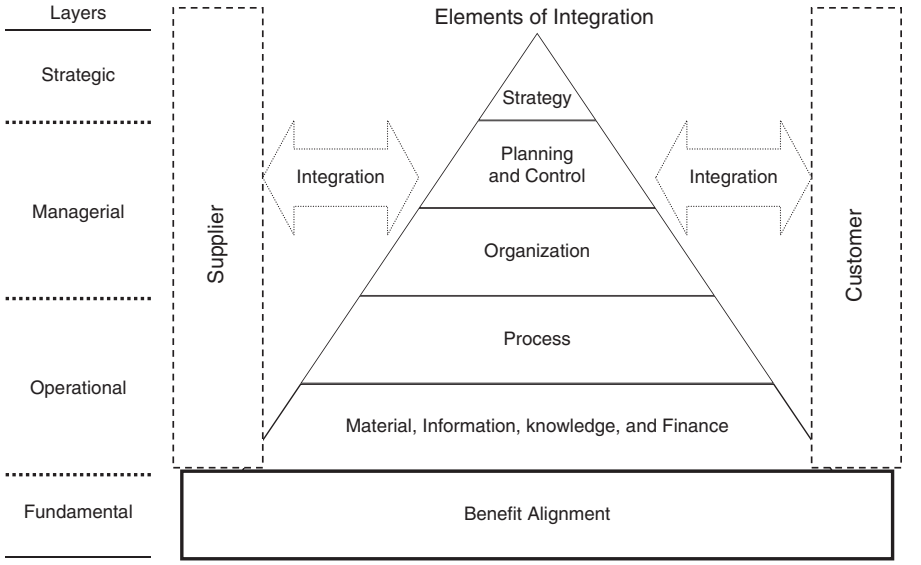


Figure 1.
A comprehensive model for supply chain integration

2.1 Benefit alignment

Benefit alignment is the foundation that could trigger all the related activities in integration and maintaining the sustainability of a pre-configured supply chain. Benefit alignment is also called incentive alignment (Simatupang and Sridharan, 2008). Since the main objective of an enterprise is to maximize the profit, a systematic integration of supply chain partners can only be achieved based on the win-win cooperative relationship. Supply chain cooperation is usually among members which either have different reward systems or are legally separate (Wang and Chan, 2010), members need to align their incentives and mode of benefit sharing (Ballou *et al.*, 2000). A formal agreement is the first step of benefit alignment, which defines the obligations and responsibilities of each entity, and establishes the mechanism of sharing interest and risks. A supply chain works well if all entities' incentives are well aligned that is, if the risks, costs, and rewards of doing business are distributed fairly across the network (Lee, 2000; Narayanan and Raman, 2004). Serious commitments, which include affective commitment, normative commitment, and continuance commitment, play a significant role in maintaining long-term and stable relationships of supply chain partners (Salam, 2011).

2.2 Material integration

Traditionally, Supply chain management involves with the control of material, information, and finance flows in a set of networked organizations consisting of customers, suppliers, manufacturers, and distributors. Addressing the integration of material flow is still commonly seen as the focus of a supply chain integration project. Material flows include both physical product flows from suppliers to customers through the chain and reverse flows via product returns, servicing, recycling, and disposal (Lee, 2000). Material integration, or material flow integration, will lead to the outcomes of reduced inventory, lower cost, shorter lead times, less product damage, and better service to customers.

The material integration is recognized with four levels: material handling, handling management, delivery decision support, and logistics alliance level (Wu, 2006), from

bottom to top as shown in Figure 2. Material handling is an essential level that refers to the collaborative activities in material handling and uniform standards of logistic facilities, such as sharing pallets and packaging, standardized logistics handling equipments, combination of loading and unloading activities, merging of delivery activities and warehouse input/output activities, and joint transportation. Handling management level refers to the cooperation of daily operational scheduling and controlling of material flow, such as joint inventory level control, joint delivery schedule, logistics activity control, and information feedback. Delivery decision support level refers to joint activities in logistics system analysis and operational decision making, like logistics cost analysis, delivery area planning, vehicle dispatching scheduling, etc. Logistics alliance level integrates long-term logistics cooperation arrangements, including mutual usage of logistics facilities, joint management team, and joint logistics improving planning.

2.3 Information integration

Bowersox and Calantone (1998) state the notion of an integrated supply chain has only become feasible when companies have access to information that is accurate, timely, and affordable. Advanced supply chain is established based on interconnected modern information systems. Information sharing could serve as an enabler that integrates all elements of group efforts into a whole (Simatupang and Sridharan, 2008). Similar to material integration, information integration is also an indispensable element of a supply chain integration project. Information systems improve the quality of forecasting, decision, planning and control, mitigate the uncertainty caused by the external market environment and internal factors of the supply chain, and consequently improve the efficiency and effectiveness of supply chain operations.

There is a lot literature discussing the information integration in supply chain, and almost all the survey-based research use information sharing as an integration measurement (Flynn *et al.*, 2010; Gimenez, 2006; Ho *et al.*, 2002; Van der Vaart and Van Donk, 2008). In practice, managers face issues such as the platform or technological tools, information format and contents, the mechanism of information utilization, and confidentiality in integration of supply chain activities.

2.4 Knowledge integration

The next level of integration is the exchange of knowledge among supply chain partners or collective learning (Simatupang *et al.*, 2002). This is clearly a deeper relationship than just information integration, it demands a greater degree of trust among partners than does the simple sharing of data (Lee, 2000).

In general, knowledge involved in supply chain operations encompasses knowledge about products, facilities, manufacturing, management, market and customers, economical environment, and the like. Usually, the focal or leading firm of a supply chain has the

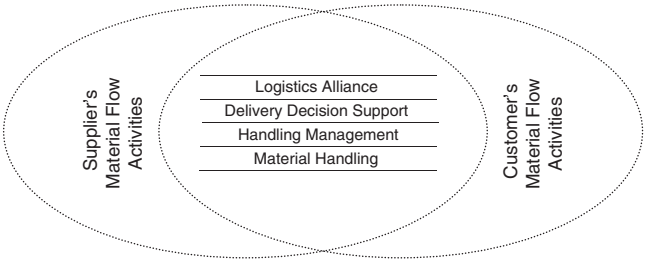


Figure 2.
Integration of material flow

responsibility of coordinating the knowledge sharing activities among participating members or partnering firms. An upstream supplier would provide knowledge to its customers about how to use, maintain, reprocess, and return its products, especially when the products are complex, vulnerable, or highly technological. In contrast, downstream retailer and wholesaler provide knowledge related to the markets and customers, and the required product specifications/design which satisfy their demands.

Many articles provide the evidence for the knowledge sharing along the supply chain. The company, Li and Fung has its managers working in the suppliers' factory, to set up production plan, balance the supply and demand, and inspect production processes with shared knowledge (Magretta, 1998). Likewise, Toyota brings about all-around improvements in its suppliers and teaches suppliers its famed Toyota production system (Liker and Choi, 2004). The company has set up learning teams, as a way to help the subcontractors and the suppliers to learn things together in order to improve the interconnected operations. Top and middle management staffs who work for Toyota and its suppliers meet under the guideline of a Toyota Sensei and go from one plant to another for improving suppliers' business processes. Suppliers also take part in the new product development as it is the well-liked practice of knowledge integration (Liker and Choi, 2004). New product introduction time can be dramatically reduced through the involvement of suppliers in the innovation process (Christopher, 2000; Lambert and Cooper, 2000). The efficient product introduction in efficient consumer response (ECR) of the grocery supply chain (Kurnia and Johnston, 2003) is another example of knowledge integration of manufacturer-retailer partnership. Similar knowledge sharing case of Wal-Mart and Pfizer is described by Lee (2000, p. 33):

> Knowledge exchange is the basis for Wal-Mart's collaboration with Warner-Lambert (now part of Pfizer) on the forecasting and replenishment of pharmaceuticals and healthcare products. Retailers such as Wal-Mart usually have the best knowledge of local consumer preferences through their interactions with customers and their possession of point of sale (POS) data. Pharmaceutical companies know about the properties of the drugs they produce and can make use of external data, such as weather forecasts, to help project demand patterns. Both parties contribute their respective knowledge and collaborate closely to determine the right replenishment plan.

In the competitive landscape of global supply chains, knowledge sharing between supply chain partners has never been more critical (Myers and Cheung, 2008), so managers should place more emphasis on the knowledge integration. Knowledge sharing is at least as significant as information sharing.

2.5 Finance integration

The purpose of finance integration is to maintain orderly financial flow. Financial flows include credit terms, payment or repayment schedules, and consignment and title ownership arrangements (Lee, 2000). Financial flows are accompanied by material flows and information flows in a harmonious way. The commitment of sharing rewards and risks will be implemented through financial integration processes. Finance integration also includes the financial help for long-term relationship partners, price negotiation mechanism, and implementation of strategic investment.

2.6 Process integration

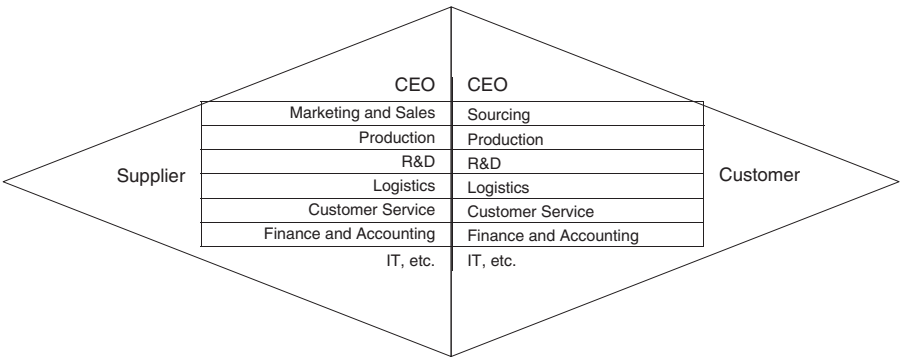
Process is a set of activities designed to produce a specific output for a particular customer or market (Davenport, 1993). One of the major initiatives of supply chain

management is to link business activities to those of critical partners, to form trans-organizational business process and focus on end users' demands. Lambert and Cooper (2000) indicate eight key processes in the supply chain, including customer relationship management, customer service management, demand management, order fulfilment, manufacturing flow management, procurement, product development, and commercialization and returns. Superficially, the goal of process integration is to realize seamless connection of supply chain activities with consistent performance standards. More substantially, it aims to enable supply chain to perform effectively and flexibly with such connection. Undoubtedly, successful process integration is a major challenge for supply chain managers. To achieve integrated supply chain processes, managers should follow three stages from internal integration, to supplier integration and customer integration. Internal integration forms the foundation of supplier and customer integration (Flynn *et al.*, 2010; Stevens, 1989), supplier integration acts as a prerequisite for the successful implementation of customer integration (Danese and Romano, 2011). Hammer (2007) provides a Process and Enterprise Maturity Model (PEMM), which centres on five characteristics that ensure processes to perform as expected on a sustainable basis and on four enterprise capabilities that allow processes to take root in organizations. The PEMM model can be used to evaluate the maturity of trans-organizational process and to find opportunity of improvement.

2.7 Organization integration

High efficiency operation of supply chain requires multiple collaborative working relationships across the organizations at all levels (Christopher, 2000). Process integration requires trans-organizational working teams and regular communication between partners. Organization integration enables trans-organizational business processes functioning collaboratively. Literature shows that trading partners have modified their organizational structures to adapt for supply chain integration, Neuman and Samuels (1996, pp. 9-10) provide an example:

> It has worked because of open communication, not necessarily at the buying/selling level. That has helped tremendously. We have made a concerted effort to open up the organization so that our distribution people are talking with their distribution folks. Our procurement people are talking with their order departments, so that really, where activity is occurring, aligning the organizations along those lines and, without having a buyer go, or a category manager go, through a sales rep who goes through a third party (Figure 3).



Source: Adapted from Christopher (2000, p. 43)

Figure 3.
Organization integration through multiple organizational linkages

To establish the settings of organization integration and make the arrangement work well, culture, and attitude are very important consideration, that they cannot be underestimated (Lambert and Cooper, 2000; Lambert and Knemeyer, 2004). Compatibility of corporate culture across channel members is necessary. Otherwise there could be potential conflicts leading to inefficient operations. As the root of Confucian culture lies in Asia, and Asia is an integral part of global supply chains, Salam (2011) suggests that an understanding of Confucian dynamics will enable practitioners to manage supply chain integration efficiently. Toyota and Honda intend to understand how their suppliers' work, they believe the beneficial partnerships occur only if they know as much about their vendors as the vendors know about themselves. They do not cut corners while figuring out the operations and cultures of the firms they do business with (Liker and Choi, 2004).

2.8 Planning and control integration

Planning and control integration is posited at a higher level of the supply chain integration model, consisting of managerial activities such as collaborative forecasting, planning, controlling, performance evaluation, and risk management. The objective of planning and control integration is to balance the supply and demand within a supply chain. Integrated planning and control activities are based on the allocation of decision right amongst the chain members (Lee, 2000; Simatupang and Sridharan, 2008). Collaborative Planning Forecasting and Replenishment is the example of planning and control integration (Szozda and Swierczek, 2013). Liker and Choi (2004) describe that Toyota and Honda supervise their suppliers through sending monthly report cards to suppliers, providing immediate and constant feedback, and getting senior managers involved in solving problems.

Reasonable performance evaluation to overall supply chain and benchmarking are the essential joint tasks of integrated operations control. Performance measures can be used to provide an accurate diagnosis of the state of the supply chain by addressing both its forward and its reverse components, to identify the level of existing integration between parties (Mondragon *et al.*, 2011). Neuman and Samuels (1996) point out that manufacturers and retailers must bridge the gaps residing originally in their perceptions of the others by creating relevant criteria for appraising supply chain performance, negotiating performance parameters with counter parties, giving and accepting rigorous, and continuous measurements along such parameters.

Planning and control integration should bring risk management into the picture and it has been given much attention as the vulnerability of supply chain increases (Tang and Musa, 2011). In reality, modern supply chain is liable to be affected by the unfavourable factors both from the outside environment and from the entities within the chain due to its characteristics of multi-entity, cross-region, and complex structure. Risk management processes, which include risk identification, risk assessment and evaluation, risk planning, risk control, and monitoring, call for joint efforts of all supply chain partners (Zhang and Huang, 2007). Ericsson has implemented a proactive supply chain risk management approach after a serious sub-supplier accident, by working closely with suppliers and also by placing formal requirements on them (Norrman and Jansson, 2004).

2.9 Strategy integration

Strategy integration refers to the activities of communication of long-term strategic goals and strategic intents, collaborative strategic investment plans, capacity and facilities planning, and interrelated implementation programs. Long-term and reliable

cooperation necessitates strategic integration. If supply chain is excluded from the horizon of strategic debate, there is imbalance, exploitable opportunities are missed and the impact of the competitive threat increased (Stevens, 1989). Liker and Choi (2004, p. 112) describe a case of strategy integration in Honda's supply chain:

> Honda uses only one top management meeting, or Jikon, to share plans with each supplier. The meetings involve a Honda team – usually two vice presidents of supplier management and several assistant vice presidents – and a supplier team. The jikon happen within three months of the end of the fiscal year, which is when most suppliers make investment decisions and other strategic plans. Only core suppliers participate in the meetings, which take place at the regional and global levels. Honda invites one supplier from each region to the global jikon in Tokyo every year; it held one-on-one meetings with 35 North American suppliers in 2003. The discussions don't extend to operational matters but instead cover only top-level strategic issues. Honda tells the suppliers what kinds of products it intends to introduce and what types of markets it plans to cultivate in the coming years. The company then discusses the supplier's strategic direction in terms of technology, globalization, major investments (such as capital goods and plant expansion), and ideas about new products. The meetings also cover improvements that will be necessary in the quality, cost, and delivery of the vendor's products.

The integration elements identified from extant literature have been reviewed and analysed. Total integration requires supply chain partners to comprehensively integrate resources (material, information, knowledge, finance, organization, etc.), activities and processes (operational and managerial), and strategy.

2.10 Interplay of integrating elements

Figure 4 shows the elements of supply chain integration and their linkages to each other. Benefit integration is the essential foundation of all other integrations and upon which the partners share rewards and risks. Strategy integration guides all other integration

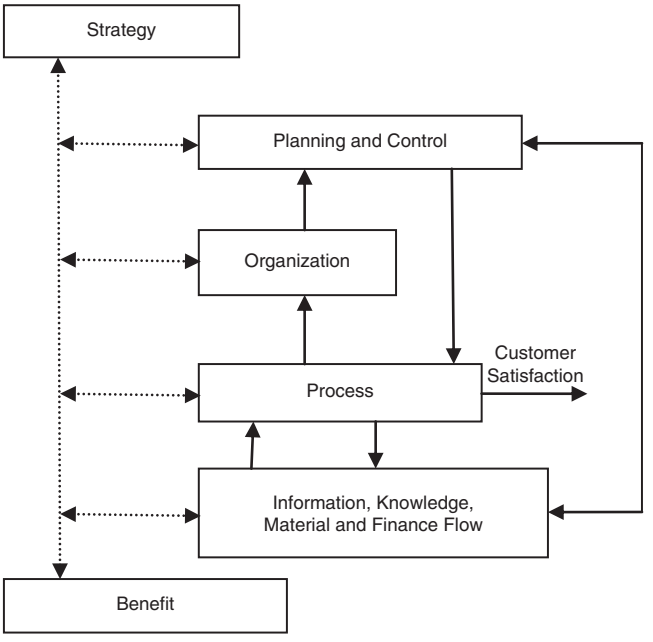


Figure 4.
The interplay of integrating elements

activities at the managerial and operational levels (as shown in Figure 1), in turn, successful managerial and operational integration would enhance strategy integration. Setting up material, information, knowledge, and finance integration ensures the allocation of proper resources to integrate inter-organizational business processes; the output of integrating process are customer satisfaction, and value-added products, information feedback, knowledge accumulation, and financial revenues. Organization integration relies on the integrated processes and is the premise for supply chain planning and control. Planning and control are parts of the managerial activities and functions of integrated organization. Integrating planning and control activities are responsible for effective and efficient processes and flows of material, information, knowledge, and finance. Saeed *et al.* (2011) find that as enterprises move from lower end to the upper end of the supply chain integration spectrum, greater attention is paid to features associated with systems integration, planning, and forecasting.

3. Implementation issues of the model

As integration has been the core of supply chain management (Fabbe-Costes and Jahre, 2007), a good understanding of the integration process is a key aspect (Gimenez, 2006). But it does not mean all relationships need strong integration. Integrating and managing all business process links throughout the entire supply chain are likely not appropriate. Since the drivers and costs even risks for integration are situational and different from process link to process link, the levels of integration should vary from link to link, and over time. Some links are more critical than others (Lambert and Cooper, 2000). Lambert and Cooper (2000) identify four fundamentally different types of business process links between members of a supply chain: first, managed business process links, second, monitored business process links, third, not-managed business process links, and fourth, not-member business process links, also categorize the members of supply chain into primary members and supporting members. Gimenez *et al.* (2012) show that supply chain integration is only effective if supply complexity is high. So managers must select the vital business linkages to allocate scarce resources and make their efforts. Factors such as business condition, company's power in supply chain, industry and market characteristics, and supply chain strategic perspective influence and determine both the optimum level of integration as well as the type of integrative activities employed (Van der Vaart and Van Donk, 2008). Van der Vaart and Van Donk (2008) disagree with the well-liked assumption that greater integration is always better. Overdoing integration may not improve supply chain performance (Gimenez *et al.*, 2012). Before trying to test whether tighter integration leads to better firm performance as lot of researchers have done (Leuschner *et al.*, 2013), whether it is the "right" integration status between supply chain partners should be identified.

About the implementation process of integration, Stevens (1989) advises that companies integrate internally first, and then, extend integration to other supply chain members. Stevens believe that its successful achievement is likely to be bottom up, evolving through four stages. Lambert and Knemeyer (2004) provide a model to elucidate the drivers behind each company's desire for partnership, allows managers to examine the conditions that facilitate or hamper cooperation, and specifies which activities managers must perform to implement the integrated relationship.

4. An illustrative case study

For illustrating the integration model and its implementation, a case study of Haier Group and Suning Appliance was conducted. Haier Group, headquartered in

Qingdao, China, is ranked worldwide as the third appliance company by unit volume (http://blog.euromonitor.com/2010/12/major-appliances-millionaires-club-new-2010-company-rankings.html); Suning Appliance, headquartered in Nanjing, China, is the largest Chinese chain retailers of home appliances. The successful case of Haier Group and Suning Appliance supply chain integration has attracted wide attention in China. The data were collected through the home page of Haier (www.haier.com) and Suning (www.suning.com) in last decade. The consistency of secondary sources was verified by interviews with managers of Suning Appliance.

4.1 Benefit and incentive alignment

Due to the surplus of production capacity in Chinese market, household appliances manufacturers face fierce market competition. The competition forces the manufacturers and suppliers to work closely in order to respond to the market demand more efficiently, and thus to reduce unnecessary operational costs and to increase the percentage of market share and the exposure of brand image.

Haier's concern is how to boost the utilization of the sales channels of Suning to increase sales, and Suning has a strong interest in the Haier's electrical products with a very strong brand. The annual sales volume of Haier products sold via the distribution channel of Suning is about RMB10 billion (approx. $1.53 billion). Huge volume of business leaves much room for both to improve services and enhance profitability by supply chain integration. In addition, the compatibility of the service concept and enterprise culture of two sides is also the basis for successful cooperation.

4.2 Information, finance and material integration

In 1993, Haier Group and Suning Appliance commenced the effort of cooperating at the strategic level by introducing the concept of strategic partnership. The preliminary works had been converted into more substantial action in 2005 when the enterprise information systems of two companies were successfully connected to each other, leading to the real-time information sharing on a unified technological platform. The integrated information systems have enabled the finance integration for both companies. Following contract terms negotiated and determined by both sides, the transactions in the payment procedures are automatically settled. Moreover, with sharing information on sales, finance, inventory, and order processing, the integration of logistics systems enables the two companies to share available inventory, trucks, and logistics staffs. Thus, Haier closed the transit warehouses in 42 cities nationwide in the second half of 2008 and dropped the inventory turnover days from 30 to seven.

4.3 Organization integration

The landmark of total supply chain integration was the cooperative agreement that focused on ECR. The agreement was signed in 2007 which states the shared business goals, resource input, responsibility, benefit, and risks sharing of both sides. Haier and Suning also discussed the details of the implementation procedures following the agreement. The incentive was to work together towards making the supply chain as a whole more responsive to consumer demand and to promote the removal of unnecessary costs through efficient product replenishment, joint product development and introduction, store assortment, and promotion management.

The first step of implementing the ECR was the restructuring of the associated organizational units. Haier set up a new department, Suning operation team. Likewise Suning also formed a special team to deal with the business related to Haier, and later

the team was named Haier division. The teams in two companies consisted of the professional staff originally from the departments of marketing and sale, logistics, customer service, and product development, respectively. These changes actually implied the depth and width of supply chain management and in turn the organization integration.

4.4 Process integration

Process integration is the key to supply chain integration. Xiwen Zou, the manager of Process Innovation Department in Haier Group, advocated that business processes and information systems could not be confined within internal enterprise, they should orient towards the whole entire supply chain, and the supply chain must be responsive. Quick response is the common objective of Haier and Suning. Based on successful information integration and guided by the synchronous collaboration and concurrent engineering concepts, the processes of order and sourcing management, promotion, customer service and return products, new product development and launch, etc. were integrated and optimized. On the basis of mutual trust and commitments, operational processes were significantly simplified (from 30 to 35 days response time), and supply chain efficiency were improved substantially.

4.5 Planning and control integration

For Haier, the core of ECR operation was described as "Customer – Order, Order – Product, Product – Cash" a three-step approach. Relying on the integrated digital channel, customer demands were transmitted directly from Suning to Haier. Based on the demand information, Haier immediately developed, designed, and produced the new products based on customer demands, then supplied to Suning to maximise customer satisfaction. Haier achieved the transformation from make-to-stock to make-to-order, and in turn improved the order fulfilment rate. Two sides planned the business operation according to negotiated planning procedures, monitored and controlled the implementation. The issues on which the joint management teams spent most of their efforts were to deal with risk events and problems they encountered in their operational processes. The Supply Chain Management Council of Haier evaluated the key performance index regularly, tried to find hidden problems and their causes, and promoted continuous improvement. By 2006, the time that Haier domestic appliance spent from new product development to large scale distribution was about three months. After the implementation of ECR, Haier shortened the time to one month. Meanwhile Suning got more and more opportunities to release Haier's new products.

4.6 Knowledge integration

Knowledge management and database marketing were the highlight of the integration. Haier provided training service to Suning staff who were responsible for sales and customer service. The training courses involved the knowledge of product specification, function, principle, and use/maintenance. At the same time Suning offered to Hailer the first hand knowledge about customer demands and market trends. By mining the data warehouse that Suning possessed, two sides strive to understand more about consumer needs, develop marketable products and improve product acceptance. They changed the previous situation in which the manufacturer made a product decision by itself, retailer sold the products passively. Suning has got the right to sell more than 50 per cent of all product models produced by Haier as the exclusive distributer or retailer, greatly enhanced its competitiveness by differentiating itself from other distributors.

4.7 Strategy integration

Every year, there would be one or two news about mutual high-level visits between senior managers of Haier and Suning on China's public media. Generally, Vice President Yunjie Zhou represented Haier Group, Vice President Ming Jin represented Suning Appliance. Regular high-level contacts became the key enablers of strategic cooperation activities. Two sides decided the targets of further co-operation, identified, and evaluated the challenges they would face, negotiated tactics to deal with existing problems, modified the principles of cooperation and developed the implementation stages of strategic plan.

The supply chain integration was described as "dismantle the wall between each other" by the Chinese media. The integration is a major success. The practice of Haier and Suning supply chain integration has embraced all the integration elements described above. In 2011, the supply chain sales volume was up to reach RMB15 billion ($2.3 Billion). Yunjie Zhou and Ming Jin were full of confidence about further cooperation and shared success. They thought that home appliance supply chain integration was the only way to revitalize the whole industry in China.

5. Discussion and conclusions

The supply chain integration model that we put forward can be summarized in Table I. Efficient supply chain integration places all essential resources of all cooperative partners together and connects all functional processes in order to effectively use resources. The goal is to operate the whole supply chain as a corporate entity, to achieve effective and efficient flows of products and services, information and knowledge, finance and decisions, to provide maximum value to the customers at low cost and high speed (Flynn *et al.*, 2010). This study develops a comprehensive conceptual model for supply chain integration based on identified elements scattered in extant literature.

Even though supply chain integration has been a highly researched topic during the last 20 years, it has often been operationalized and measured differently (Leuschner *et al.*, 2013). There is still little consensus on how to capture the essence of supply chain integration (Van der Vaart and Van Donk, 2008). Extant studies define integration in different ways and base their questions in their surveys on a limited number of indicators and operational measures (Fabbe-Costes and Jahre, 2007). Leuschner *et al.* (2013) suggest authors, referees, and editors to agree to a consistent standard of reporting for empirical survey-based research. In this connection, this paper has attempted to form a consensus based on the proposed comprehensive model shown as in Figure 1 and Table I. It contributes to the knowledge by presenting a comprehensive model from the perspective of supply chain integration based on the evidence extracted from secondary data and analysis. The model provides direction for future research to determine integration variables of supply chain and their interconnectivity. Because the nature of supply chain management is about integrating the operations and bridging among participating members, the model can be also used to categorize the knowledge required for supply chain management.

The comprehensive model described above embrace the details of integration elements with reasonable structure. It is a normative model that can guide managers to integrate resources and activities in supply chain management by helping them to recognize the contents of supply chain integration. The comprehensive framework is also an interface model like the OSI model in computer network. The interface model

Level	Elements of integration	Contents of integration
Strategic level	Strategic integration	Communication of strategic goals and strategic policy
		Collaborative strategic investment plan
		Capacity and facility planning
		Interrelated implementation programme
Managerial level	Planning and control integration	Collaborative forecasting, planning and control
		Collaborative performance evaluation
		Risk management
	Organization integration	Multiple inter-organizational linkages
		Regular communication
		trans-organizational working team
		Compatible organization culture
Operational level	Process integration	Customer relationship management
		Customer service management
		Demand management
		Order fulfilment
		Manufacturing flow management
		Procurement
		Product development and commercialization
		Returns
	Finance integration	Credit terms
		Payment or repayment schedules
		Consignment and title ownership arrangements
		Financial help to each other
	Knowledge integration	Product knowledge
		Producing knowledge
		Facility knowledge
		Management knowledge
		Market and customer knowledge
		Environment knowledge
	Information integration	Platform or technological tools
		Information format and contents shared
		Mechanism of information use and confidentiality
	Material integration	Logistics alliance
		Delivery decision support
		handling management
		Material handling
Fundamental level	Benefit alignment	Mechanism of sharing rewards, costs and risks
		Long term commitment

Table I.
Summary of supply chain integration

supplements the SCOR model with the function of describing the interfaces between supply chain partners. The framework may be helpful for IT engineers and managers striving to develop supply chain integration software systems.

One of the limitations of the study is the use of secondary sources for data collection and an interview based illustrative case to demonstrate the application of the model. We only provide enough or least evidence, not complete evidence. The conceptual model needs further empirical research. We focus our discussion on the total supply chain integration model, rather than the specific details of integration elements. Each element of supply chain integration still has many unresolved theoretical and practical issues. These offer avenues for further research on supply chain integration.

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