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## KNOWLEDGE MANAGEMENT AND INFORMATION TECHNOLOGIES: A CONCEPTUAL MODEL FOR SUPPLY CHAIN INTEGRATION

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**Abstract:** The purpose of this article is to build a supply chain integration conceptual model using the knowledge management and information technologies as a resource of a firm and how these attributes influence the supply chain integration. In this article, it was used a literature review of the supply chain integration, knowledge management and information technologies to build a conceptual model to improve the supply chain integration of firms. With the literature review a conceptual model for supply chain integration was developed, in this model it was proposed that supply chain integration is influenced by strong information, logistics and organizational integration and those elements also are influenced by knowledge and information technology management. The model proposed can become a guideline for firms whose supply chain integration is weak and want to increase their relationship with customers and suppliers.

**Keywords:** Supply chain integration, firm resources, knowledge management, information technologies.

## INTRODUCTION

A major change in the paradigm of modern business is that companies no longer compete on an individual basis, but now compete as supply chains (Lambert et al., 1998). Considering this situation, the study on supply chain has become one of the main topics between corporate executives and academics have found in recent years, the changes that have come forward to compete in global markets have made relations between firms more complex so the supply chain integration in the industrial environment is key to the success of companies.

The competitive pressures have direct effects in the supply chain and his integration. The integration of activities inside and outside the company has become a major

challenge for executives and academics of the supply chain (Carter et al., 2009). To explain this situation, the resource-based approach could help to explain why some supply chains outperform others and gain sustained competitive advantage (Barney, 1991). Nevertheless, since the introduction of the resource-based view of the firm in the strategic management literature (Wernerfelt, 1984; Barney, 1991) the framework has been rarely used in supply chain integration literature.

This article was divided into 5 sections; the first one is the introduction. On the next section, it was developed the supply chain integration and resource-based approach of the firm theoretical background. Then it was explained the methodology used in the literature review and the model construction. The fourth section is the discussion about the contributions from the resource-based approach to supply chain management. The final sections are conclusions and proposals for future research.

## LITERATURE REVIEW

### SUPPLY CHAIN INTEGRATION (SCI)

Since its introduction by consultants of Booz Allen in 1982 (Oliver and Webber, 1992), the term supply chain has gained much attention (LaLonde, 1997). Subsequent research has developed new schools of thought, books and articles have been published on the topic, trying to make new contributions to the supply chain topic and areas related with (Stevens, 1989; Stock, 2009).

During the last decade, the way to do business has changed dramatically, the changing technologies, mainly in information and communication, e-commerce and the globalization has changed the way that firms do business (Bagchi & Skjoett-Larsen, 2002; Carter, Monzcka, Ragatz & Jennings, 2009).

In the literature, the supply chain is viewed as a competitive tool derived from the pressures and its integration (Lambert, Cooper, & Pagh, 1997, 1998; Carter, Monzcka, Ragatz & Jennings, 2009). Because of the different paradigms in the form of doing business the supply chain integration has become one of the main activities for the firms to improve their competitiveness.

The supply chain integration activity begun in the 80, when the client-supplier relationships were created, these relationships were attributed to three factors (Awad and Nassar, 2009): (1) the manufacturing activity is made in a global context, where the local markets are subjects to global standards. (2) constant stress influences the organizational structure and their manufacturing activities. (3) the development of products and productions systems environmentally benign.

On the other hand, Handfield and Nichols (1999, p. 5) they mention that the revolutions of information and communication technologies, the growth of the global competence levels and the development of new inter-organizational relationships, has caused that supply chain integrates. Factors like collaboration, trust, information sharing, similar technologies have caused the firms to be individual entities to become chains of integrated processes (Akkermans et al., 1999; Power, 2005).

With the paradigm shift within international business and greater pressure to make better transactions with lower costs in less time and meet the demands of costumers, the supply chain integration concept has gained important attention in the literature (Gimenez et al., 2012; Zhang and Huo, 2013).

In the literature exists different definitions about supply chain integration, Flynn et al. (2010, p.59) define as” the degree to which a manufacturer strategically collaborates with

its supply chain partners and collaboratively manages Intra and inter-organization processes. The goal is to achieve effective and efficient flows of products and services, information, money, and decisions, to provide maximum value to the customer at low cost and high speed”. Another definition of supply chain integration is “a strategic tool, which attempts to minimize the operating cost and thereby enhancing values for the stack-holders (customers and shareholders) by linking all participating players throughout the system; from supplier’s suppliers to the costumers” (Kwon & Suh, 2005, p. 26). Finally, Chen et al. (2009, p. 26) define as “a set of continuous restructuring activities aimed at seamlessly linking relevant business processes and reducing redundant or unnecessary processes within and across firms”.

The above definitions emphasize that in order to achieve an integration of the supply chain, an inter and intra-firm collaboration is fundamental so that the individual efforts are added up to achieve optimal functioning of the supply chain. Additionally, developing a conceptual definition of the supply chain integration will help to understand better, the theories, their indicators, the implications in administrative matters, as well as their academic importance (Fabbe-Costes & Jahre, 2008; Chen et al., 2009; Zhang & Huo, 2013).

## KNOWLEDGE MANAGEMENT AND SUPPLY CHAIN INTEGRATION

The resource-based view and knowledge-based view of the firm serves as foundation that knowledge can be a strategic resource for achieving sustained competitive advantages (Hult et al., 2004) for knowledge to be a strategic resource must meet several criteria (Barney, 1991), first the knowledge must be *valuable*, meaning that knowledge should help to create outputs that are important to

customers. Second, the knowledge must be *rare*, this means that is infrequently and that close substitutes are not obtainable. Finally, the third criteria are that knowledge is *inimitable*, meaning that buying or copying the resource is difficult (Hult et al., 2005).

In their article Hult et al. (2004), suggest that the management of supply chain involves facilities and activities that transcend the firm boundaries, and they argue that firms that are better able to create and use the supply chain knowledge should outperform others (Barney, 1991).

Previously to develop knowledge in supply chains, Hult et al. (2004), suggest that achieved memory, knowledge acquisition activities, information distribution activities, and shared meanings affect positively the outcomes of the firms. Also, they consider that knowledge development may enhance supply chain outcomes. In the same logic knowledge is an important source of coordination (and thus be central to the organization functioning (Hansen, 2002; Hult et al., 2004).

With the logic of the RBV Craighead et al. (2009) identified eight critical knowledge elements in the formation of supply chain performance: memory tacitness, accessibility, quality, use, intensity, responsiveness, and learning capacity.

Academics have identified that knowledge-based dimensions represent an important gap in the supply chain management field (Croom et al., 2000), these gaps also represent an important opportunity. So, knowledge development in the firm is the key to achieve superior supply chain performance (Hult et al., 2005).

Another form to understand the knowledge importance in supply chains was developed by Done (2011, p. 5), he develops a three phases framework to unify and integrate knowledge in a supply chain. Phase

1, vicarious learning leads to knowledge transfer from supply chain transfers. Phase 2, continued experiential learning, these lead to the upgrading of the knowledge and develop supply chain competence. And, phase 3, internal exploitation/external exploration knowledge balance, where the seeks to combat potential diminishing returns and performance in the long term.

Within the knowledge creation phase in the supply chain, the empirical literature review shows that knowledge creation includes an improved firm image, employees' satisfaction and client satisfaction (Coulson-Thomas, 2004). Also, the supply chain members have to be committed in interconnected processes to share information, build infrastructure aimed to create new knowledge (Malhotra et al., 2005).

Lin and Wu (2005) suggest that in order to create knowledge within organizations, collaborative relationships should be established with both client and suppliers. A similar study is that of Weck (2006) that focuses on the importance of management in the client relationship, standing out in joint research and development projects where the exchange of specialized knowledge, the definition of roles and responsibilities are critical factors for inter-firm knowledge creation.

ICT also plays a fundamental role in knowledge creation within supply chains (Cassivi, 2006). Kodama (2005) examined that the development of new products in a high technology field requires the fusion and integration of several technologies within a suitable network both inside and outside the firm in order to share, transfer and create knowledge.

Regarding the knowledge storage in the supply chain, Walsh and Unsong (1991) mention that there are five repositories of knowledge, the individual, the culture,

formal procedures and systems, structures and external activities. The empirical results demonstrated that a strategic orientation towards knowledge, a culture of learning and practices related to the firm's human resources have direct effects with the retention of knowledge in the firms (Nelson and McCann, 2010). Kong et al. (2011) suggest that the human resources department of organizations along with practices related to innovation and learning play an important role in the storage of knowledge.

On a research Hult et al. (2004) analyses the creation, storage, and transfer of knowledge and how these make that some supply chain outperforms others, they found that those with better storage tend to seek to acquire more knowledge and therefore have a better performance.

In terms of the transfer and exploitation of knowledge with a focus on the supply chain, the management of information, materials and financial flows becomes knowledge that can be used to optimize the supply chain integration (Hadaya and Cassivi, 2009). Other authors mention that if the information is properly contextualized and the member of a supply chain know how to react to the information received, we speak of a knowledge transfer and the firms can extend their intra-firm processes to an inter-firm process (Ke and Wei, 2007; Hadaya and Cassivi, 2009). It can be considered a knowledge transfer in the supply chain when "the transfer of knowledge allows the members to orchestrate the operation of the supply chain and obtain positions of competitive advantages. The lack of knowledge transfers has been consistently found as the fundamental failure factor in the supply chain management" (Ke and Wei, p. 207, 2007).

The knowledge transfer also creates value to customers and suppliers in the global supply chain, its main results show that the

transfer of knowledge is influenced by the market structure and the similarities between customers and suppliers (Myers and Cheung, 2008). Also, Wang et al. (2008) developed a learning perspective and developed a framework to emphasize the effective transfer of knowledge in the supply chain, where they highlight that the joint learning of all supply chain members increases the competitiveness.

Regarding the above framework, initial knowledge transfers between supply chain partners will occur in the form of explicit codified knowledge, as the knowledge evolves into internal functional capabilities through learning by doing, the tacit knowledge will increase (Kogut and Zander, 1992). The active communication becomes a key activity to develop tacit knowledge in the supply chain regarding the implementation of practices (Done, 2011).

## **INFORMATION TECHNOLOGIES AND SUPPLY CHAIN INTEGRATION**

The use of information technologies (IT) within supply chains has been increasing with the development of integrated IT, their use began in the early eighties mainly in terms of software, hardware, connectivity. They mention that the IT that have been used are: bar codes in logistics systems, the use of electronic data interchange (EDI), use of material requirement planning (MRP), business solution such as enterprise resource planning (ERP), the internet and web services for communication between members of the supply chain (Miraz et al., 2016).

In this sense, Simichi Levi et al. (2003) mention that the basic objectives of IT within the supply chain are: provide information and visibility, provide a single point of information contact, make decisions based on the total information of the supply chain and facilitate collaboration with the other members of the supply chain.

The IT can also be important sources of competitive advantages for the firms and therefore for supply chains (Benjamin et al., 1984; Porter and Millar 1985). In particular, Porter and Millar (1985) argued that IT can change the structures and rules of competition, create competitive advantages and new business opportunities. Within the supply chain, Bowersox et al. (2002) pointed out that IT is essential to obtain competitive advantages facilitating centralized planning, but with decentralized operations. Likewise, Tripathy et al. (2016) found that IT is a key element for firms to effectively execute activities within the supply chain and obtain a competitive advantage.

These competitive advantages can be reflected in the supply chain, Levary (2000) suggest that IT in the supply chain provide a reduction of time, inventories, minimization of the whip effect and improvement of the effectiveness of distribution channels. Prajogo and Olhager (2012) highlight three benefits: (1) IT allows firms to increase the volume and complexity of the information that needs to be communicated among members; (2) IT allows firms to provide important information in real-time for members, such inventory levels, delivery status and production planning, permitting firms to manage and control their activities in the supply chain; (3) IT facilitate the alignment of forecast and scheduling operations between firms improving inter-firm coordination.

About the effects of the relationship of IT and supply chain integration, Prajogo and Olhager (2012) they found that the technological capabilities of the firm related to IT and the information sharing through them have important effects on the operational integration of the supply chain. In relation with operational integration of the supply chain, the use of IT to the information

exchange is essential to achieve a supply chain integration and benefits of this process (Vanpoucke et al., 2017).

Also, Wu, Chuang and Hsu (2014) found that trust, commitment, reciprocity and power are the background of the information sharing and integration among members in the supply chain, they proved that the previous situations are important to determine the exchange of information and collaboration. Furthermore, Cai et al. (2016) investigate factors such collaboration and responsibility among supply chain members, finding that collaboration in the supply chain positively affects organizational responsibility and IT serves as moderators of this relationships so they are key players in a supply chain.

Another research that aims to investigate the IT and supply chain integration was made by Gonzalez et al. (2015), they investigate the impact of information systems, the firm performance and the supply chain integration, their results show that IT capabilities are important for the firm performance, but IT integration does not lead to an improvement in the performance of the firm. Regarding the relationships between the IT and supply chain integration, it only improves performance when there is a direct connection with customers and suppliers, but it does not improve the performance of the entire supply chain.

Narasimhan and Wook (2001) identify critical factors for the IT utilization in supply chain integration activities such as infrastructure support, the management of value creation, the logistics operations and the performance of the management of the supply chain.

## MODEL BUILDING

The supply chain integration seeks to reduce the barriers that prevent the coordination, control and communication

of the processes of the different firms within a supply chain (Kaufman, 1997). With the supply chain integration, a predominant aspect is the belief that by integrating the supply chain the firms will improve their competitive position (Lambert et al., 1998; Frohlich and Westbrook, 2001; Bagchi and Skjoett-Larsen, 2002), it has positive effects on the individual performance of the firms (Bagchi and Chun Ha, 2005; Van der Vaart and Van Donk, 2008), while others have a positive impact on the performance of the supply chain (Narasimhan and Kim, 2002; Lee et al., 2007).

The benefits related to the integration of the supply chain within the framework of RBV are observed in a reduction of costs and an increase in the value of the focal firm, its shareholders and members of the supply chain (Lee, 2000). In the RBV framework, the interaction of the supply chain involves a set of planned investments in the construction of long-term relationships and the standardization of processes, which creates a complex network, this relationship is difficult to imitate by the other supply chains (Koufteros, et al., 2010; Chen et al., 2009). In addition, capacities are created that are difficult to imitate and that is worked in a synchronized and close way, specific knowledge is shared (Blome et al., 2014; Schoenerr and Swink, 2012; Rosenszweig et al., 2003), which increases efficiency and the coordination of the supply chain (De Vita et al., 2011).

## THE MODEL COMPONENTS

For the development of the conceptual model developed in this paper, the following components were identified: the first component is knowledge creation (Hult et al., 2004; Craighead et al., 2009; Croom et al., 2000), knowledge storage (Walsh and Unsong, 1991; Nelson and McCann, 2010), knowledge

transfer (Hadaya and Cassivi, 2009; Ke and Wei, 2007) and knowledge execution (Done, 2011).

The second component was considered information and communication technologies, where IT usefulness factors are identified (Simichi Levi et al., 2003, Narasimhan and Wook, 2001), IT compatibility (Prajogo and Olhager, 2012) and IT ease of use (Cai et al., 2016).

All of the above components influence information integration (Rai et al., 2006; Barrat y Oke, 2007; Caridi et al., 2014), the logistics integration (Stock et al., 2000; Rai et al., 2006) and the organizational integration (Flynn et al., 2010; Cousins and Mengue, 2006; Hines and McGowan, 2005).

The conceptual model developed proposes that the compatibility, ease of use and usefulness of IT positively influence the use of IT in the supply chain. Likewise, information technologies have a positive influence on knowledge management and both influence the integration of information, organizational integration and the integration of information. Finally, these three elements influence the integration of the supply chain as figure 1 shows.

## DISCUSSION

With the model component identified it was developed some hypothesis regarding the supply chain integration, the first hypothesis developed is that the IT utility, IT ease of use and IT compatibility influences positively the IT. The IT makes information visible, keeps firms in touch and facilitates decision making and collaboration between supply chain participants, and also modifies competitive structures by reducing costs related to delivery times, inventories, reducing the whip-effect and production forecasts.

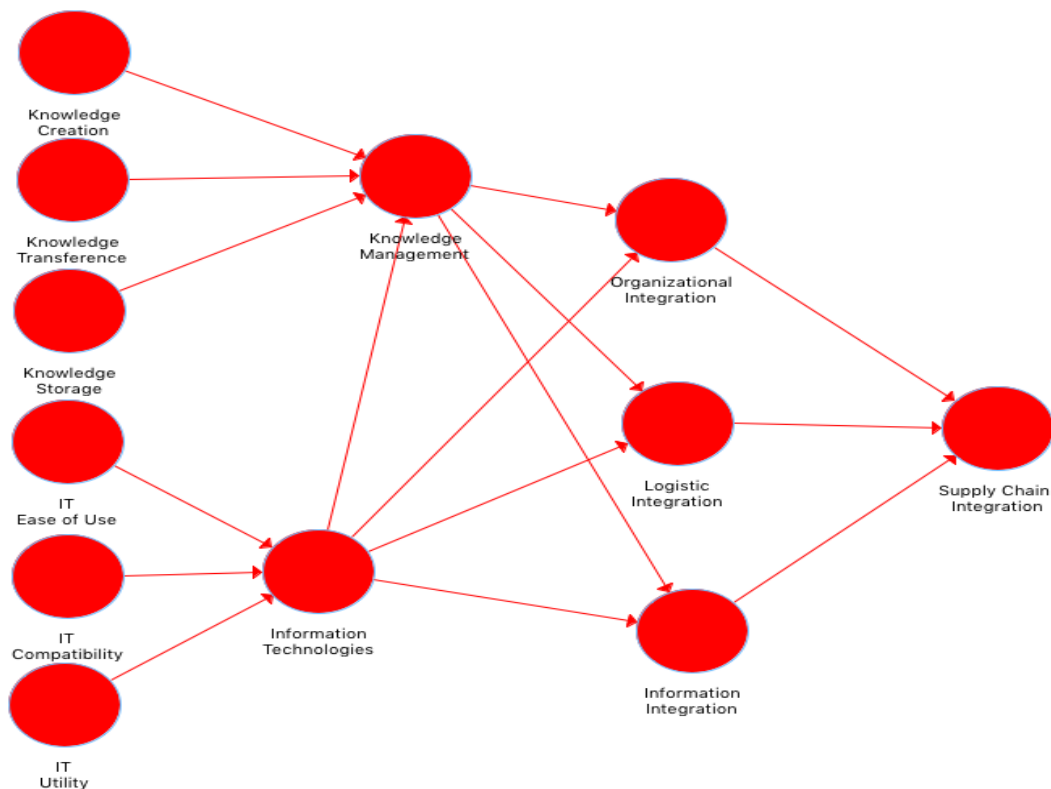


Figure 1. The conceptual model for supply chain integration.

Source: Own elaboration.

Also, the IT acts as intermediaries in the exchange of information, so they are sought to be easy to use and any person is able to receive, interpret and use the information transferred. The IT must be compatible so that the information that is transmitted can arrive when it is needed and not have to use decoders to interpret the information. And finally, generate useful information to the firm that can be transferred to the entire supply chain and generate value.

The second hypothesis is that knowledge creation, knowledge storage, knowledge transference and IT influences positively on knowledge management. The knowledge creation involves great coordination between supply chain members, must be committed and open to interchange information, processes, financial and human resources to develop new knowledge. The knowledge

creation in the supply chain seeks to strengthen the relationship between partners.

The transfer of knowledge translated in terms of information flows, materials and money, implies the development of IT that facilitate availability, interpretation and decision making within the firm, these decisions will have repercussions on the value thrown to the client. This point also involves great coordination among the participants in the supply chain. So that the knowledge created, stored and transferred can finally be executed by the firms in the supply chain, the development of information technologies that improve those activities have become necessary.

The third hypothesis establishes that both knowledge management and IT positively influence organizational integration, logistical integration and the integration of information.



Finally, the fourth hypothesis was developed. In this sense, organizational integration, logistical integration and information integration have a positive influence on the integration of the supply chain.

The conceptual model developed proposes that the compatibility, ease of use and usefulness of IT positively influence the use of IT in the supply chain. Likewise, information technologies have a positive influence on knowledge management and both influence the integration of information, organizational integration and the integration of information. Finally, these three elements influence the integration of the supply chain.

## CONCLUSIONS

The main objective for supply chain integration is to reduce the barriers between the members of the supply partners, these barriers could be the communication, information sharing, logistics or knowledge. This model develops how the knowledge and information technologies influences

on the three components of supply chain integration, the logistics integration, the information integration and the organizational integration and these on the general supply chain integration.

This model can help firms to increase their supply chain integration with clients and suppliers and reduce the cost related with these activities such the whip-effect, misunderstanding of information, high logistics costs regarding time, deliveries or IT incompatibilities.

A suggestion for future research, it is to test empirically using a structural equation model or another statistical technique to know how information technologies and knowledge management has influence in the supply chain integration.

Another suggestion is to add more variables that firms have such as total quality management, innovation management, strategic planning or production management and also test the impact they have to improve the supply chain integration and design strategies and better practices between the firms involved in a supply chain.

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