

Supply Chain Performance: An Agile Supply Chain Driven By Information System (Is) Capabilities

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Abstract

The characterization of the current business practices by variations in demands and differences in customer requirements has motivated many firms to be responsive. Responsiveness is an increasingly important skill for firms in today's global economy; therefore firms must be agile. Supply chain agility can be regarded as an operational strategy, concerning customer responsiveness and flexibility in the supply chain. But it can be hampered by fragmented employment of information systems (IS) according to Broadbent et al., 1999. The research therefore aims to analyze the role of information system (IS) capabilities in achieving supply chain agility in manufacturing firms. Fifty-three (53) manufacturing companies, basically medium/large companies formed the sample of the study based on random sampling technique. Data analysis was done using multiple regression analysis. The result revealed that an organization's supply chain agility through its information system capabilities has a positive influence on its supply chain performance. The study however recommended that organizations should be more committed to other areas of operational performance other than organizational learning in their supply chains since remaining competitive goes beyond acquiring and disseminating information only.

Keywords: Agility, Supply Chain, Flexibility, IS, Performance

Introduction

In the past few years supply chain agility has gained prominence as a tool for competitiveness in the business environment. The current business practices have been characterized by variations in demands and different customer requirements thus, the ability of an organization to respond to these variations becomes crucial. Responsiveness is an increasingly important skill for firms in today's global economy; hence firms must be agile.

There are several definitions of supply chain agility in literature. However, a clear distinction is made by Christopher (2000), between speed (meeting customer demand in the context of shortened delivery lead times), leanness (doing more with less) and agility (responding quickly to changes in demand in terms of both volume and variety). Thus when talking of agility, a main focus is in “responding to changes” in a useful time frame, in a volatile marketplace.

Supply chain agility can be regarded as an operational strategy, concerning customer responsiveness and flexibility in the supply chain. But it can be hampered by fragmented employment of information systems (IS) (Broadbent et al., 1999). Studies have shown that the development of IS has rapidly reshaped business processes and supply chain agility has been especially affected (Christopher, 2005). However, the way IS integration, in the context of supply chain agility, improves operational performance is poorly understood (Fawcett and Magnan, 2002; Mabert et al., 2003).

Information systems (IS) plays an important role in supply chain management, as an enabler in achieving supply chain integration and agility (Gunasekaran and Ngai, 2004, Power et al., 2001). As Breu et al. (2001) argue, ‘information systems are seen to assume a fundamental role in developing agility’. A key characteristic of supply chain agility is the instant availability of information to manage an ‘on demand’ business operation. IS integration provides the basis for information sharing and exchange and organizations (Yusuf et al., 2004; Auramo et al., 2005). There is some evidence that the lack of information sharing and sparse information prohibit supply chain coordination and lead to greater operational inefficiencies (Patnayakuni et al., 2006).

An integrated information system requires the integration of communication, data and application (Muller et al., 2007; Ross, 2003) to enable consistent and real-time connectivity among function units across supply chains (Rai et al., 2006). However, IS cannot, per se, create any sustained performance or values (Powell and Dent-Micallef, 1997). Therefore, it is important for companies to integrate resources and embed them in their social and cultural context (Barua et al., 2004) to develop operations and workflow coordination (Rai et al., 2006).

Information system capability can thus be seen as the ability of an organization's collective information system to adapt and support changing requirements of the business with respect to the flexibility dimensions of product development, sourcing, manufacturing and logistics as well as other strategic goals.

Gaining a better understanding of the relationship between IS capabilities and supply chain agility has managerial as well as theoretical implications. The role of agility in the supply chain is to increase the speed and flexibility with which activities can be accomplished. The faster flows can be accomplished through the supply chain, the quicker customer needs can be satisfied. The process of moving goods from a customer order through supply, production and distribution of products to the customer requires

information capabilities that can respond to constantly changing conditions, including final customer demand. Because the level of agility in a supply chain can determine the efficiency and effectiveness of the collective efforts, it is essential that firms become more knowledgeable about the role of information system capabilities in achieving agility.

The study therefore seeks to analyze the role of information system capabilities in achieving supply chain agility in manufacturing firms and the hypothesis put forward is that an organization's supply chain agility through its information system capabilities has no positive influence on its supply chain performance.

Literature Review

The Concept of Agility

The thinking behind solutions to help companies to deal and respond to business environment has since the 1990s focused on the agility concept as a means for responding to business changes (Goldman et al, 1995; cited in Ismail and Sharifi 2006). Jackson and Johansson (2003) argue that agility as a business concept cannot be considered as an aim for any company, however it can be considered as a requirement needed by any company to have a high degree of competitiveness inside this highly dynamic and complex business environment. Agility has been widely recognized as a winning approach for companies and can be considered as the main strategy for staying in the dynamic business environment (Ismail and Sharifi, 2006).

Agility as a concept has been first introduced to be applied to the manufacturing function, where it was defined by Kidd (1994, cited in Jackson and Johansson, 2003) as "...agile manufacturing can be considered as the integration of organisation, highly skilled and knowledgeable people, and advanced technologies, to achieve co-operation and innovation in response to the need to supply our customers with quality customised products". Brown and Besant (2003; cited in Narasimhan et al., 2006) define agile manufacturing as the ability to deal with the changes in the business environment market quickly and effectively.

More recently it has been introduced to the whole company where it has been defined by Goldman et al. (1994, cited in Swafford et al., 2006) as the organisation which has a dynamic nature and an ability to gain a competitive advantage through this dynamic nature which enables it to focus on developing knowledge and flexible processes to be able to react to the environmental market changing conditions.

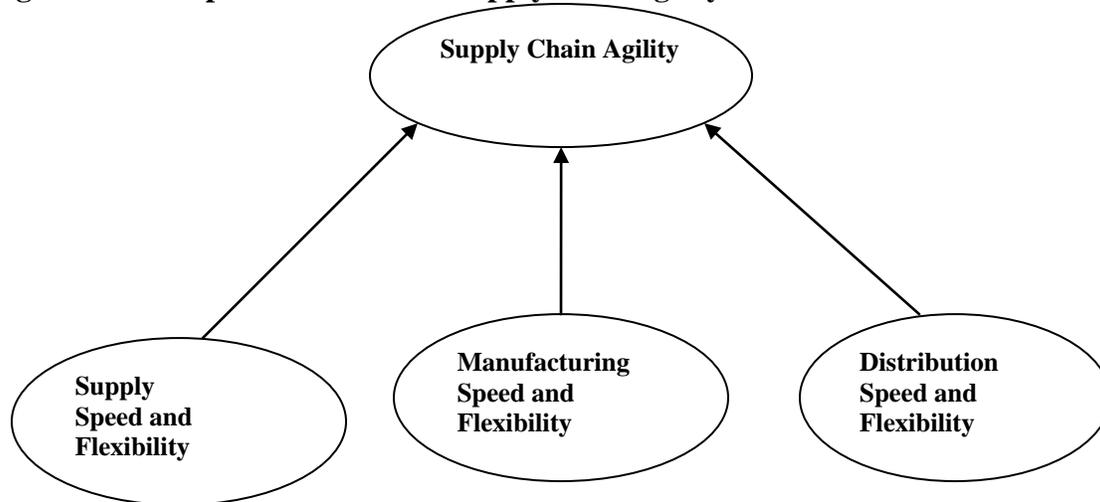
Agility in supply chains is critical for competitive advantages as it helps to explore and exploit opportunities in fast changing markets. Firms are increasingly dependent on information technology (IT) for supply chain management as a competitive tool to facilitate such agility. However, little research has been done on the role of IT on supply chain agility.

Edmund, et al. (2001), give a very in-depth definition of "Supply chain agility". Two concepts inherent in agility are:

- Speed: time it takes to ship and receive a good
- Flexibility: Degree in which a firm is able to adjust the time in which it can ship or receive goods.

Since a supply chain is made up of three components viz: supply, manufacturing and distribution, supply chain agility can therefore also be described as shown in figure 1 below.

Figure 1: Conceptual definition of supply chain agility



Determining the degree of agility of a firm's supply chain depends on how well the components of the supply chain are configured to include speed and flexibility such that the level of supply chain agility increases as the levels of both speed and flexibility increases. However, where deficiencies exist in the supply chain the firm then becomes vulnerable to competitors.

To Christopher (2001b) this new survival frontier not only implies reduced response time, but also low cost and product quality. From this point of view agility becomes one of the sides of the logistics triangle as described by Carvalho (2001a). Time has been recognized as a competitive advantage for quite some time. According to Stalk and Hout (1990), time is a fundamental business performance variable. But nowadays time is not enough to satisfy the customer's needs. It is necessary to answer to their needs with adequate products and creating value. It is necessary to have agility.

Thus agility can be seen as the ability of the organizational structure, information systems, logistic processes and human resources of a business or supply chain to quickly and successfully adjust to needed changes in demand volume and/or variety providing a customer adjusted low cost and high quality product.

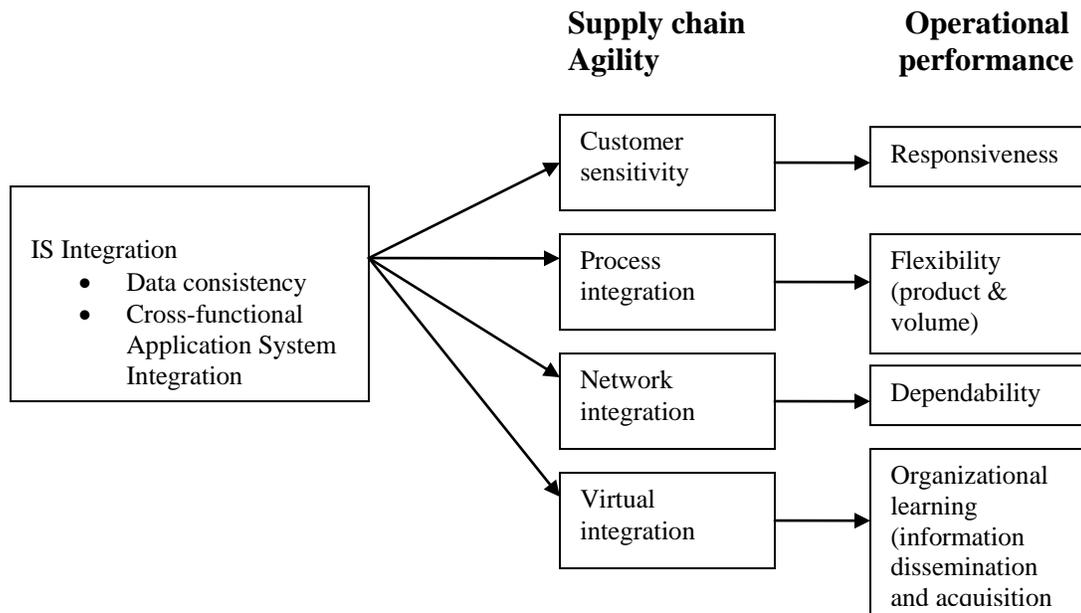
Four dimensions of agile supply chain practices can be identified. They are:

- Customer sensitivity: emphasizes customers and markets, including customer-focused logistics and rapid response. Supply chains are becoming demand-driven rather than forecast-driven in order to effectively respond in real-time demand. Firms rely heavily on forecasting techniques to predict manufacturing and inventory based on historical data due to lack of direct feedback from market. But IS integration within and among organizations enables them to capture data on demand, leading to

customer-focused supply chains (Christopher, 2000). Firms are more likely to gain competitive advantage through fast delivery and product variety rather than price. Therefore, the effectiveness of supply chains can be measured by its responsiveness (Lee and Billington, 1992). Through sharing and transferring real time information among suppliers and customers, IS encourages a fast response to market requirements.

- Network integration: there is a growing recognition that companies need strategic partnerships with shared targets to compete in competitive markets. Therefore, in order to sustain competitive advantage, it is critical to leverage the strengths and competencies of partners to realize fast responsiveness to market requirements (Christopher, 2000). Thus dependability among partners, such as the performance of suppliers in terms of speed and reliability of delivery is key (Narasimhan and Jayaram, 1998).
- Process integration: is related to uncertainty across the supply chain, placing emphasis on self management teams instead of standardization so that core modules of products can be delegated within networks of agile competitors. Therefore, alliances among various suppliers, manufacturers and customers will be inevitable (Christopher and Towill, 2000), and it enables collaborative working methods such as joint product design. Therefore, while focusing on their own competencies, companies are much more likely to increase product variety and improve the ability to handle orders with special customer requirements. Meanwhile, with the availability of real time demand data, it improves company volume flexibility - that is, increasing or reducing production based on demand. Flexibility is another important operational dimension which can improve the company's competitiveness (Martinez and Perez, 2005), and in the context of supply chain, it is a significant measure for supply chain performance (Vickery *et al.*, 1999).
- Virtual integration emphasizes leveraging people and information along the supply chain. Supply chains can be structured around the flow of information to ensure that members within organizations along the supply chain have access to relevant information (Tippins and Sohi, 2003). IS integration enables more effective information gathering and dissemination between customers and suppliers to make consensus focused development more efficient, thus contributing to organizational learning (Tippins and Sohi, 2003). Given the complex and often dynamic nature of supply chain management, organisational learning has been presented as one key dimension of competitive supply chains (Hult *et al.*, 2000).

Figure 2: Framework for the operations impact of IS capabilities on agile supply chain



Agility versus Leanness

Agility must not be confused with leanness. Lean manufacturing origins, as mentioned by Chase (2001), can be traced to the Toyota Production System and has one of its main focus on waste reduction. Christopher (2000) discusses this point aiming agile strategies to less predictable environments where demand is volatile and needed variety high, and lean strategies to high volume production of a low variety of products in predictable environments. Carvalho (2001b) referring to the logistic triangle argues that agility has to do with searching for the optimisation of time and cost objectives while leanness is related to the system's ability to adjust to optimal cost and quality strategies.

Agility versus Flexibility

Although flexibility is seen as a key variable in an agile organization, as referred to by Christopher (2000), they differ in concept. Whilst flexibility stands for the ability to quickly respond to changes in volume or in the product mix in predictable markets, agility, as affirmed by Goldman (1995), agility goes beyond it. Agility is related not only to the ability to quickly change volume or product mix in unpredictable markets but also the ability to transform the company's structure and organization to fully match the new

demand. In this sense flexibility is only a means to achieve agility, as implicitly referred by Narasimhan (1999).

The Agile Approach to Supply Chain Management

According to Alan et al. (2005) the approach aims to create a responsive structure and process to customer service demand in a changing market place. The key characteristics of an agile approach are:

- Inventory is held at as few levels as possible.
- Finished goods are sometimes delivered direct from factory to customer.
- Replenishment at different levels in the supply chain is driven by actual sales collected at the customer interface.
- Production is planned across functional boundaries
- Supply chain systems are highly integrated, giving clear visibility of inventory at all levels
- Minimum lead times are developed and used.
- The principles of the postponement of production are purchased.
- The majority of stock is held as work in progress awaiting final configuration, which will be based on actual customer requirements.

The role of information system in achieving supply chain agility

Supply chain management involves the control of both material flow and information flow among suppliers, manufacturers and customers (Leverly, 2000) through the processes of information sharing, communications and transmission. Furthermore, it enhances supply chain processes by virtually eliminating the barriers of individual organizations to achieve higher flexibility and responsiveness on market requirements (Sanders and Premus, 2002).

Naturally, it follows that an organization's agility depends on its supply chain being agile. However, achieving supply chain agility is a function of other abilities within the organization; specifically supply chain flexibility and information system (IT) integration.

Methodology

The study was carried out in Lagos State, Nigeria. Lagos State was created in May 27, 1967. The State as trading port has recorded history dating back to the Portuguese explorers of the 16th century; situated in the South-Western corner of the country, this elongated State spans the Guinea Coast of the Atlantic Ocean for over 180 kilometres, from the Republic of Benin on the West to its boundary with Ogun State in the East. It extends approximately from latitude 6°21' North to 6°41' North and from longitude 2°45' East to 4°20' East. Of its total area of 35775 square kilometre, about 7875 square kilometre or 22% is water (Adebayo, 2006).

According to Somuyiwa (2010) Lagos is the most advanced and industrialized metropolitan state in the country and sub Saharan Africa. Its people enjoy a very high standard of living. Basic commodity oriented industries play a key role in the Lagos economy, making Lagos a strong market for high value processed consumer goods.

The methodology for this study was based on a sample which was randomly selected consisting of 100 manufacturing companies. The data collected was analyzed using multiple regression analysis. The study employed both primary and secondary sources of data. The main instrument used in collecting data was the questionnaire. A total of one hundred (100) questionnaires which was based on a five point likert scale were used to collect information from the one hundred randomly selected firms about supply chain practices and the use of ICT capabilities in achieving supply chain agility in these manufacturing firms. Fifty three questionnaires were completed and returned representing a response rate of 53%.

Results and Discussion

Table 1: Multiple Regression Model

Model	Multiple R	R ²	Adjusted R ²	Std. error of the estimate	F-value	Sig.
1	0.668	0.446	0.354	0.55508	4.831	0.005*

a. Predictors: (constant), Responsiveness (R), Flexibility (FLEX), Dependability (DEP), Organizational learning (OL)

b. Dependent Variable: SCA

Source: Authors Computation, (2011)

Table 2: Coefficients of regression analysis

Model		Unstandardized coefficient		Standardized coefficient		
		B	Standard Error	Beta	t	Sig.
1	(constant)	2.909	0.937		3.103	0.005
	R	0.002	0.100	0.270	0.024	0.981
	FLEX	-0.072	0.088	-0.130	-0.818	0.422
	DEP	0.143	0.093	0.372	2.077	0.091
	OL	0.498	0.143	0.564	3.478	0.002

Source: Authors computation, (2011)

The regression model in Table 2 explains only 44.6% of the variance in supply chain performance of an organization's information system's capabilities in driving supply chain agility. In other words, all the variables in the model can only contribute 66.8% of level of explanation. This is statistically significant as it was confirmed in Table 1 by F-value of 4.381 that is significant at 95 % confidence interval. Hence, the hypothesis that an organization's supply chain agility through its information system capabilities has no positive influence on its supply chain performance is rejected while the alternate hypothesis that an organization's supply chain agility through its information system capabilities has a positive influence on its supply chain performance is accepted.

Again, from table 2, OL has the highest significant contribution of 0.564 while the other variables R, FLEX and DEP although made significant contributions but a lesser contribution.

Conclusion

The main objective of the paper was to explore the concept of agile supply chain through IS capabilities in enhancing the supply chain performance. Based on literature

explored, because agile supply chain is a winning strategy for growth, it is evident that it is a strategy for an improved supply chain. Agile supply chain is triggered by “change” which is the only constant thing in the business environment.

Furthermore, the findings reveal the mechanisms of how IS integration can facilitate greater agility in the supply chain, leading to improved operational performance, such as responsiveness, flexibility, dependability and organizational learning.

A key to the success of an organisation is to align agile supply chain strategy to the differentiation strategy in order to meet the overall objective for having a competitive advantage since customer expectations are never static.

The study therefore recommends that organizations should be more committed to other areas of operational performance other than organizational learning in their supply chains since remaining competitive goes beyond acquiring and disseminating information.

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