WORK IN PROGRESS PAPER

Flexibility in supply chain management

ABSTRACT

Literature describes several developments in supply chain management. Flexibility is considered to be an important differentiator in the current market place. Several papers already emphasized the need for flexibility although little attention is paid to how operational activities incorporate flexibility in their supply chain practices. In this paper, emphasis is put on the dyadic buyer-supplier relationship, marketing activities and manufacturing in order to achieve flexibility in supply chain management. These aspects are illustrated with three case studies in which supply chain structures have been evaluated in two different kinds of markets. In the end, the role of flexibility is evaluated and how this can lead to a competitive advantage.

KEY WORDS

Flexibility, Supply Chain Management, Optimalisation, Efficiency

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1. INTRODUCTION

The role of supply chain management (SCM) has become increasingly important for firms in highly competitive (mature) markets, and we have recently seen, also in economic downturns.. Ketchen & Hult (2007) describe this competitive rivalry among firms as “supply chain versus supply chain” instead of “firms versus firms”. A well-coordinated supply chain process is difficult to imitate for competitors since it becomes more difficult to compete on product level. Globalization and liberalization in the market place are important drivers for the growing competition together with the changing demand of the consumer. A shift arose from a more technology-oriented view (in the past) towards a point in time where collaboration and trust become important along the partners in the supply chain. Effective management of relationships in supply chain management is a necessity in order to withstand competitive pressures and economic downturns.

Therefore, Hult et. al (2004) describe that supply chain management is not anymore a support function in order to implement a business strategy; it is specifically meant to drive a firms’ performance and supply chain management becomes a key element of the overall strategy for the entire chain.

Currently, changes in the environment (socio-political, changing demand etc.) are the cause for increasing uncertainty in the market place. In order to deal with this, flexibility in the supply chain becomes more and more important. In this paper we want to explore the term ‘flexibility in supply chains’ in order to understand the phenomenon better and be able to define specific research and managerial implications in the field.
In this paper we first define a research question and describe the applied methodology. In chapter 3 we describe the results of the literature research into the phenomenon of flexibility and in chapter 4 we describe the cases we studied. The paper ends with a conclusion, implications for management of organisations, limitations of the research and suggestions for further research.

2. RESEARCH QUESTION AND METHODOLOGY

This is a working paper about flexibility in supply chains. We want to learn what is already known in the field and what spots can be defined for further research, also considering the current practices in supply chain management.
We used the following research question for this paper:

> How can flexibility in supply chains be defined and used in order to improve the competitiveness of the focal company ?

In order to find the answers to the research question, we conducted a literature study and an exploratory cases study in which we studied three different cases. In order to narrow the scope, certain business processes have been selected and how these processes have incorporated flexibility in supply chain management.
We think that literature study is necessary to put the research question in perspective of already pertained research on supply chain management en what has been concluded on flexibility. We have taken a wide variety of literature, trying to look at the issues from a broad perspective. The result of the literature research is presented in chapter 3, concluding on the term flexibility and defining it. As from the literature research it proved that flexibility in supply chain management has not been extensively researched before, we decided to set up an exploratory case study, with three cases. These case were randomly selected, most important reason for selection being the availability of material at the time of this work in progress research. We elaborate on this choice in the limitation section of this paper. The case study was descriptive by nature and should be followed up by a in depth, structured way, including data collection procedure, sources, interview methodology and analysis. The result of the case elaboration is presented in chapter 4.

3. SUPPLY CHAIN MANAGEMENT

Current literature about supply chain management describes several meanings of supply chain management (SCM). It becomes clear that there is not an explicit or unified description. Especially the level of detail between the descriptions differs. For example, Mabert and Venkataramanan (1998) describe supply chain management as a series of units that transform raw materials into finished products and deliver the product to the customers. This is a typical ‘push’ approach, pushing the raw materials into the next processes of the chain, towards the end market. A more holistic approach is given in the definition of Harland (1996) who describes supply chain management as managing business activities and relationships within an organization, with immediate suppliers, with first and second tier suppliers and customers along the supply chain. However, the descriptions of supply chain management remain vague since it is not clear what is meant by ‘business activities’. Cohen & Lee (1988) succeeded in defining a clear description of supply chain management. They clarify that supply chain management consists of both intra- and inter related business activities of a (focal) company. The intra-related part refers to the raw material or component procurement by independent suppliers, through manufacturing and distribution (inter-), and concluding with successful delivery of the product to the retailer or a customer (Cohen & Lee, 1988). It becomes clear how supply chain management evolved from traditional purchasing and logistics function into a broader strategic approach to materials and distribution management known as supply chain management (Tan, 2001).

3.1 Evolution of SCM

In the past (1950s and 1960s), traditional supply chain was merely technology driven: great emphasis was put on minimizing unit production costs with little product or process flexibility (Tan, 2001). Instead of integration, collaboration within the supply chain between several players was regarded as unacceptable (Tan, 2001). From that moment in time, the intense global competition forced manufacturing businesses to shift the emphasis on greater design flexibility, low costs and high quality products (Tan, 2001). Strategic partnerships between parties arose and the shift from a technology oriented view to an integrated approach becomes necessary in which trust and commitment became important. This ‘trust-‘oriented view of companies include several characteristics:

- Improve efficiency across the supply chain: manufactures exploit supplier strengths and technology in support of new product development (Ragatz et al. 1997).
- Understanding of critical functions of firm’s own activities affecting the entire value chain of the company (Tan, 2001);

- Coordinating the flows of materials and information between suppliers, manufactures and customers (White et al. 1999; Narasimhan and Carter, 1998; Trent and Monczka, 1998).

Currently, the effectiveness of the supply chain depends on the integration of several activities within the entire chain (Simchi et al. 2000). A higher level of integration with suppliers and customers in the supply chain is expected to result in a more effective competitive advantage (Johnson, 1999; Lummus et al., 1998; Narasimhan and Jayaram, 1998). Therefore, supply chain management is now considered to be about the integration and management of key business processes across the supply chain, from product design to final delivery and from customers to suppliers through service providers and strategic partners (Lambert and Cooper, 2000).

3.2 Flexibility in supply chains

In the history of SCM literature, high speed and low cost supply chains have been important drivers for companies. Depending on the market the firm is in, these supply chains work perfectly in steady conditions since the entire supply chain is focused on economies of scale, delivering quick supply for the least amount of money. However, these supply chains are not able to react on sudden changes in demand.
Several articles explain how current market conditions require supply chains that are capable of dealing with sudden changes of demand and strategies instead of a cost and/or speed oriented view solely. Changing market demand, differing supplier lead time, product quality and information delay (Giannoccaro et al, 2003) are sources of uncertainty that create a need for building ‘flexible’- supply chains that can deal with these changes and preferably in a better way then their rivals. In doing so, a competitive advantage can be achieved.

Literature about flexibility in supply chain management describes several definitions about this concept. Viswanadham & Raghavan (1997) describe this concept as the ability of a business process to effectively manage or react to changes with little penalty in time, cost, quality or performance. Lee (2004) explains the flexible ability of a company in terms of three distinctive components. These components are general characteristics of flexible supply chains since it is not described how these components influence the functional operations in the supply chain:

1. Adaptable: Adjust the supply chain’s design to meet structural shifts in markets, modify supply network strategies, products and technologies (Lee, 2004).
2. Alignment: Create incentives along the partners within the supply chain for better overall performance (Lee, 2004)
3. Agility: The ability of a supply chain to respond to short-term changes in demand or supply quickly and handle external disruptions smoothly (Lee, 2004).

Although alignment is considered to be one of the aspects of flexibility (Lee, 2004), we consider this aspect as a prerequisite for a supply chain in order to deal with uncertainty: a supply chain can only deal with changes when common agreement is made between all the supply chain partners and change of strategies is necessary.

As a conclusion of the above we define flexibility in supply chains as:
Flexibility in supply chains is the possibility to respond to short term changes in demand or supply situations of other external disruptions together with the adjustment to strategic and structural shifts in the environment of the supply chain. Flexibility thus combines agility and adaptability (Lee, 2004)

3.3 Aspects of flexibility

In this paragraph we describe flexibility in more detail, related to three aspects:

1. Buyer-supplier relationship
2. Demand driven and the role of marketing
3. Production/manufacturing

Aspect 1: Buyer-supplier relationship
The roles of external and internal drivers are important for increasing supply chain flexibility in a business. External drivers relate to demand volatility and seasonality whereas internal drivers can be described as low commonality between products and product schedule uncertainty. However, these changing circumstances

also emphasize the importance of the dyadic relationships between the focal company and its clients in the buyer-supplier relationships. This relationship can be described as 'sourcing' and 'supply'. The former one refers to the ability of the focal company to choose and change among suppliers on the basis of supplier performance. According to Wadha et al. (2008), this is referred as routing flexibility. The choice for a supplier depends on several parameters that differ largely among suppliers (examples are demand, inventory, lead-time, etc.). This dynamic control is addressed to select the best supplier based on the cost of all three parameters and throughout the supply chain. Although large emphasis is put on costs, it is questionable whether a cost-oriented view for switching between suppliers is the most important reason to achieve flexibility, taken from a buyer perspective.
Supply refers to the ability of a supplier to increase suppliers' responsiveness (Tachizawa & Gimenez, 2005): the ability to efficiently change schedules on a frequent basis (Krajewski et al., 2005) or a supplier's ability to produce efficiently in small quantities (Fisher et al., 1997). Because of this, the management of relationship with suppliers is of crucial importance. Wadha et al. (2008) also emphasize the role of 'trust' along the partners in the supply chain since larger emphasis is put on the flow of communication and the willingness of these nodes in the chain to support a dynamic supply chain configuration.

Aspect 2: Demand driven and the role of marketing
The fundamental goal of supply chain management is to create customer value. The role of marketing plays an important role in this. Without appropriate marketing activities, supply chain efficiency does not find out what the customer values (Rainbird, 2004). Radjou (2000) states that manufactures must be able to respond to 'dynamic trade', which is defined as the ability to satisfy current demand with customized response. Traditionally, marketing was a function that was more externally oriented whereas supply chain management is merely internally oriented. According to Jutter et al. (2007), marketing and supply chain management is hence between those that define demand with those who fulfill it.
Although we consider a customer-oriented approach as an important characteristic of a 'flexible' supply chain, it does not necessarily create superior value for the customer. In order to create superior value, a supply chain must have the ability to support this (Kumar et al, 2000) with its supply chain processes. Jutter (et al., 2007) uses the term Demand Chain Management as it combines the strengths of marketing and SCM by shifting the focus to the customer. Next to this, the competitive environment of a company also indicates the role of manufacturing in the supply chain.

Aspect 3: Production/manufacturing
Literature can be found about the history of manufacturing and how this has undergone several changes (just-in-time, total quality management etc.). Flexibility in manufacturing is not prior limited to machine flexibility since manufacturing (system) consists of several interconnected subsystems (Viswanadham & Raghavan, 1997). Because of this, it requires more changes in the firm's activities. Mentzer (2004) states that highly innovative products in uncertain, constantly changing environments need a supply chain production system that is focused on strategic flexibility and speed to market. Based on the competitive environment of a company, Viswanadham & Raghavan (1997) explained several forms of flexibility aspects in manufacturing:

1. Mix flexibility: ability of a system to simultaneously produce a number of different products in a given period (broad product line and caters to different market segments.
2. Volume flexibility: ability of a system to change significantly the production level and the composition of the product mix in a short time span (volatile markets)
3. New Product Flexibility: Ability of a system to add or substitute new products to the product mix in a short time span (technology intensive markets)
4. Delivery time flexibility: Ability of a system to reduce the order

As a conclusion of the above we further define flexibility in supply chains as:
Flexibility in supply chains is the possibility to respond to short term changes in demand or supply situations of other external disruptions together with the adjustment to strategic and structural shifts in the environment of the supply chain. Flexibility thus combines agility and adaptability (Lee, 2004). Flexibility furthermore combines mix, volume, new product and delivery time aspects.

In the next paragraph we will contribute to the research question from three cases.

4. CASE STUDY

As from the above described literature research it became clear that flexibility in supply chain management has not been extensively researched before. Therefore we decided to set up an exploratory case study, with three cases. These case were randomly selected. The three cases have been evaluated in relation to flexibility in supply chain operations, described through buyer-supplier relationships. The first two cases describe the supply chain activities in the textile market, ZARA and Italian luxury closing brands. Textile apparels have certain common characteristics such as a short product life cycle, high volatility, low predictability and a high level of impulsive purchasers in the end market. Therefore the elements agility and adaptability can be explored. The third case describes the flexible ability of a famous automotive company (Toyota), trying to shed more light on mix, volume, new product and delivery time aspects.

Case 1: Zara

Dutta (2002) describes the supply chain structure and activities of the Spanish retailer Zara. The founder of the Spanish retail group Inditex, Amancio Ortega Gaona compared consumers of clothes as commodities. This emphasizes the notion that the taste of customers can change week by week.

The case of Zara clearly describes in what way marketing activities are aligned with supply chain practices. The main objective of their marketing activities is to react swiftly: Zara is able to design, produce and deliver the product to the customer in just one month. The main reason for this is that Zara does not forecast the designed clothing. Fabrics and garments are the only materials to be purchased on the basis of forecasts. Their main strength is to capture real-time information on the shop floor and develop designs on the basis of this information: so-called ‘commercial managers’ conceptualize the type of garments and the kind of fabric it will be made off. Based on this real-time information, garments and its technical specifications are prepared in strong collaboration with other departments along the supply chain. In doing so, the final design is ‘assembled’ on the basis of current customer demand. This gives Zara a strong competitive advantage since they integrated the product development with up-to date marketing activities and information. Also, Zara does not invest in expensive commercials or campaigns. Most of Zara’s marketing budget is spent on information technology and communications to keep ahead of day-to-day trend information. This gives the supply chain flexibility and a competitive advantage.

Another important differentiator is that Zara puts more emphasis on offering different styles rather then increasing the volume per item. The flexible supply chain can produce quickly enough, so large numbers in stock does not add value. Their suppliers are found in Spain, India and Morocco. This enables Zara to switch between suppliers when performances are lacking or due to external market conditions.

A high level of vertical integration (including independent companies) exists in the supply chain of Zara. All product development and (final)production facilities are kept in-house: dying and processing activities of fabrics are fully controlled (not out-sourced). Non-strategic activities are fully outsourced and the actual ‘assembly’ processes of pieces are fully outsourced. Since all the necessary raw materials are present when market data is received, the fabrics can be translated into super-fast end products.

As a preliminary conclusion, the ZARA case indicates the agility and adaptability aspects of flexibility in SCM.

Case 2: Italian luxury clothing brands

The research of Brun (et al. 2008) describes general findings after an extensive research of 12 Italian (luxury) clothing companies. In relation to the general supply chain structure of most Italian firms (luxury segment), the upstream part of the supply chain consists of several sourcing and manufacturing echelons. Several tiers exist in which many activities are outsourced. Activities in the process that are of less critical value are completely outsourced (sewing) whereas the critical activities are to be kept in house (cutting). The downstream section of the supply chain is very short since direct contact exists between the selling points of the brand and the manufacturing facilities. In this niche market, large emphasis is put on high quality products. The focal company in the supply chain carefully monitors suppliers in order to meet their obligations. Sourcing activities are started when orders are confirmed: this is done in order to avoid excessive stocks since demand can fluctuate. The production is considered to be as ‘tailor-made’.

The manufacturing activities produce small batches of products; this offers the opportunity to customize products more easily then a mass-production system (mix flexibility). Also, the focal company provides all planning activities and has high level of power in the supply chain: there is little collaboration between the manufacturers and the focal company. Main benefit of this strategy is that large control is present of the focal company. Since small batches are produced, it is possible to deal with fluctuating demand (volume flexibility). Since most of the products are hand-made, switching costs are relatively low since little use of machinery is used for switching between products. Although this case assumes that flexibility is present in the supply chain,

I consider this flexible ability as a result from the fact that small batches are being produced (and hand-made). It is questionable whether this flexible ability remains similar when demand (and thus volumes) fluctuates to higher volumes.
Luxury brands prefer direct contact with the customer. Now the supply chain flexibility is based make to order strategy, low volumes, low switching costs and low stocks.
As a preliminary conclusion, the Italian luxury clothing brands case indicates the agility and adaptability aspects of flexibility in SCM.

Case 3: Toyota's business system
In the automotive industry, supply chains are extensive and include elements of producing based on several forecasting techniques. The amount of money invested is large and fixed. Key trend in the automotive industry is the increase of the variant numbers on individual models and standardisation of components in the supply chain. This means that models can be adjusted to the individual tastes of customers and new models are developed and produced continuously in order to meet the changing market demand. The uncertainty in the market place is translated into mix flexibility and volume flexibility in order to be competitive in the market place (Howard et al. 2006).

Womack et al. (2007) describe the difference between mass production supply chains and 'lean' supply chains. Toyota can be considered as the first automobile brand that introduced a clear need for flexibility in its entire business system. Toyota's 'lean philosophy' is not only restricted to its manufacturing system: it describes a philosophy that incorporates a collection of tools and techniques into the business processes to optimize time, human resources, assets, and productivity while improving the quality level of products and services to their customers (Becker, 2007). Currently, several automobile brands clearly recognize the strength of 'lean thinking' in relation to increase flexibility in their supply chain activities.

In the dyadic relationship between a buyer and supplier, emphasis is put on how the work can be done smoothly in order to improve quality and reduce costs. Best value procurement becomes more important instead of merely a cost-oriented approach that ensures a close relationship with suppliers. First tier suppliers are incorporated into the production development program. This means that suppliers make their own engineering decisions instead of designing on the basis of blueprints solely. Next to this, these suppliers have their own 2nd tier suppliers under itself who supply parts for these components. This ensures that the exchange of information is possible horizontally which improves the collaboration between suppliers. This collaborative aspect is of major importance in a relationship when market demand (or other influences) requires changes of demand in the buyer-supplier relationship. This collaborative aspect among suppliers is rather uncommon in many industries since sharing information increases the risk of loosing the next bidding process among suppliers to an assembler.
Related to flexibility, the following can be said. Since Toyota strives for a long-term relationship with its suppliers and also pursues a single-sourcing strategy for their strategic components, it does leave the OEM vulnerable for disruptions. But, the single-sourcing strategy is also a means to establish a long-term and flexible relationship with a supplier. Since each supplier shares its destiny with other suppliers and Toyota, the level of collaboration horizontally and vertically is higher. Therefore, a singly sourcing strategy itself is considered to be as hazardous, the relationship itself is far more flexible then a more economic-oriented relationship between a buyer-and-supplier.

As a preliminary conclusion, the Toyota cases sheds light on the mix, volume, new product and delivery time aspects of flexibility in SCM.

The results of the case study are summarised in table 1, following different aspects of flexibility (vertical axes).

Buyer-supplier relationship		Zara	Luxury clothing brands	Toyota
	1. More than one qualified supplier for each item	+	-/+	-/+
	2. Frequent evaluation of suppliers' performances & ability to switch	+	+	+
	3. Transparent info-flow	+	-	+
Product development				
	1. Ability to design various products in a short time-span	+	-	+
Manufacturing & production flexibility				
	1. Ability to handle mix & volume flexibility	+	-	+
	2. Postponement	+	-	+
	3. Low switching costs	+	+	+
Marketing				
	1. Demand driven	+	+	+
	2. Involve knowledge of other departments in the total supply chain	+	-	+

table 1: summary of the cases and how these cases illustrate the level of flexibility in their supply chain operations.

5. CONCLUSION, IMPLICATIONS FOR MANAGEMENT OF ORGANISATIONS, LIMITATIONS OF THE RESEARCH AND SUGGESTIONS FOR FURTHER RESEARCH

CONCLUSION

The literature research and the case study show importance of flexibility in supply chain practices of a company. The concept of flexibility in literature is not new in general, it is in its application to supply chains. Theory emphasizes the need to incorporate flexibility (also applicable to SCM) in order to react on changing customer demand, an important conclusion is that customer's perception of a brand must be translated into supply chain strategies: the need for flexibility is determined by the kind of market the product competes in. Although flexibility appears to be a clear success factor in the cases of Zara and Toyota, the 2nd case study illustrated how a niche-oriented brand does not have to pursue flexibility in order to become successful. A niche brands translates its' highly quality brand perception of customers into sourcing strategies in which is chosen for suppliers who meet these high quality standards.

In all the three cases, direct contact with the market is an important aspect. The more intermediate steps are present in the downstream part of the supply chain, the less likely it becomes to incorporate the actual voice of the customer in supply chain activities.

In order to differentiate a brand (supply chain) from another competitor (supply chain), speed to market is an important differentiator. Flexibility is the means to achieve this. The speed to market heavily depends on the point in the supply chain in which 'push' activities become 'pull'- driven. The common understanding in this strategy is that the less intermediate steps or activities are 'pull-driven' in order to differentiate, the greater speed to market will be achieved.

In order to accommodate a large product variety and change in volumes to be produced, the dyadic relationship between buyers and suppliers are of vital importance. A true flexible buyer-supplier relationship is only achieved when a strong collaborative relationship exists in which information is shared continuously. The benefits of this strong collaboration are not only translated in larger flexibility: it goes beyond a more cost-oriented collaboration between a buyer and a supplier. This enables suppliers to create best value into a product since large attention is put on incorporating their (best) existing knowledge from both parties. In the end, the product quality depends on this. This also enables the possibility to react actively on demand volatility since suppliers are willing to corporate.

As a result of this work in progress research we use the following working definition of flexibility in supply chains:

Flexibility in supply chains is the possibility to respond to short term changes in demand or supply situations of other external disruptions together with the adjustment to strategic and structural shifts in the environment of the supply chain. Flexibility thus combines agility and adaptability as well as mix, volume, new product and delivery time aspects.

IMPLICATIONS FOR MANAGEMENT OF ORGANISATIONS

Up to now supply chains have been set up to fulfil customer demand, through detailing the way goods and services float through the chain. By adding flexibility to SCM, management is able to respond to deviations from the surroundings of the chain, as well as fluctuation from within the chain.
For the short term, flexibility means responding to changes in demand or supply quickly and handle external disruptions effectively. For the longer term, it means meeting structural shifts in markets, modify supply network strategies, products and technologies (including mix, volume, new product and delivery time aspects).
By applying the principles of flexibility managers can swiftly work within a designed and set up supply chain, without changing it structurally. That enables managers to devote time and attention to other important elements of their job.

LIMITATIONS OF THE RESEARCH

This research is very descriptive by nature, consisting of an initial literature research and an exploration of three (random) cases. This obviously limits the possibilities of drawing conclusions from the research. In new research in the phenomenon of flexibility these shortcomings should be resolved. The above described research can help to do so.

SUGGESTIONS FOR FURTHER RESEARCH

This research shows the possibilities for more flexible supply chains. Further research has to provide evidence on the specific factors that determine flexibility, as given in our preliminary definition. It has also to be investigated how flexibility meets demand volatility and at the same time, deal with external market disruptions or the aspects of longer term and strategic perspective. This is maybe a new challenge, taken from a supply chain development perspective. Further research should also overcome shortcomings of this research.

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