Supply Networks: how to identify the different strategies for supply chain management in organisations?

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Abstract

The intensification of competition, globalisation and partnerships development led organisations to see their relationships from the viewpoint of enterprise networks. These networks, also known as supply chains, delivery chains or, more recently, supply networks, connect organisations from raw materials to delivery of final products to the customers. So, the client, when buying a product, supports these networks, whose object is the profit of all the partners through the satisfaction of buyers with their products and services. However, the large variety of products at current time is the biggest challenge to the management of enterprise networks and made the companies inquire if management strategies applied to these networks would have only a single characteristic, as, for instance, if management applied to the textile network may be the same as applied to the food industry network. In this context, this paper studies four well defined strategies of supply network management from the viewpoint of efficiency, flexibility, responsiveness and agility. These network management strategies take into account the type of product sold and the marketplace in which the companies operate. Furthermore, this paper describes a methodology to identify the correct supply chain strategy in relation to demand uncertainty and supply uncertainty. Finally, this paper propose a case study to apply the methodology.

Keywords: Supply Chain, Lean Supply Chains, Flexible Supply Chains, Responsive Supply Chains, Agile Supply Chains.

1 Introduction

Relationships between companies have become consolidated as these start to understand the need to operate in networks to be able to compete on current markets. For an organisation, it does not suffice just to develop products and services: it is necessary to meet the requirements and also the desires of clients in relation to these requirements.

For this purpose, and seeking competitivity in their markets, the companies have had to make an appraisal and also establish a position within their supply chains, including the flow of their products and services within these chains, with the aim of meeting all the requirements of their clients.

Companies start to get to know their players on the network and systematically enhance their processes. They start to understand the real needs of the markets, so they can launch and produce products and services desired by the consumers, even if sometimes they do not even imagine such possibilities, as is the case with high technology products. In addition, they have started to understand that each consumer is different, as are the needs of each segment.

If the consumers and the markets are different, how can there be only one strategy for supply chains?

Thus, we can say that these strategies of the supply chain can be different according to the approach taken up by this network, which means the search for the elimination of waste, the ability to make the processes more flexible, and the capacity to respond to markets, not to mention agility in serving volatile markets. Effectively, these strategies relate to the characteristics of the products made by the network that could be of an innovative or functional character.

This way, the main purpose of this work is to present the different supply chain strategies that exist at present and show how to identify the network strategy which is most appropriate for the type of product made by the organisation.

2 Supply Networks (Supply Chains)

The study of supply networks has become an emerging topic within the universe of operations in which the relations between the companies and their clients have started to be monitored and appraised, to say how they could contribute to greater competitivity of the organisations.

According to Slack, Chambers & Johnston (2009), no network exists independently, all operations being a part of a larger network, interconnected with other operations. A network consists of a set of relationships between clients and suppliers, responsible for the flow of goods, from the source of the raw materials through to the end user. Figure 1 shows a simple network with its flows.

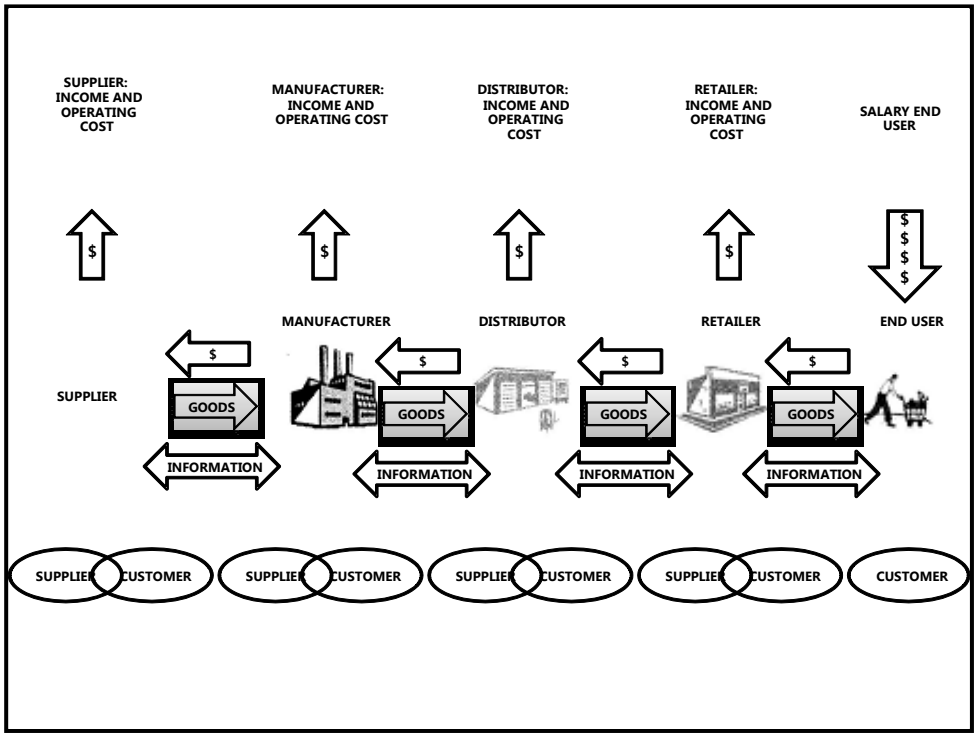

Figure 1: Supply Network. Source: Adapted from Corrêa 2010.

Corrêa (2010) points out that the management of supply chains involves a lot more than just cost management, as this affects other aspects, including performance, speed and reliability of deliveries, the quality of the products, and, finally, the flexibility with which the network can adapt.

2.1 Supply Chain Strategies

Along the 20th Century, the companies have implemented different strategies for production, such as agile, responsive, flexible and lean manufacture (Godinho Filho, 2004).

These strategies have been implemented in order to reach the performance targets for production. These performance targets as presented by Slack et al. (2009) and Hill (1993) involve cost, flexibility, speed, quality and reliability, and are responsible for the competitivity of companies.

However, the increase in competition led the organisations to surpass their borders, operating in supply chains and thus reaching out to suppliers and clients with the aim of continuing to reach their targets and remaining competitive.

This has meant that, over the last few years, many authors including Christopher (2000; 2007), Chase, Jacobs & Aquilano. (2006), Pires (2009), Corrêa (2010) have studied different types of management strategies for these networks, proposing that they are directly related to manufacture paradigms.

Therefore, it is possible to say that these paradigms started to be part of the strategies to be adopted by the different supply chains. Thus, what is known as agile manufacture can be known as a supply chain which is agile when dealing with the companies present in the network as a whole.

2.2 Lean Supply Chain (LSC)

Lean thought was responsible for the major change of production paradigm in the 20th Century. Naylor, Mohamed & Berry (1999) said that this concept consists of development of a continuous flow of value to eliminate all the waste, including that of time. This thought can be translated in the Toyota Production Systems (TPS), whose focus, according to Agarwal, Shankar & Tiwari (2006), lies in the reduction and elimination of waste.

Womack & Jones (2004) say that new ideas emerge from the set of conditions under which the old ideas seem to no longer work, which explains the fact that the Japanese car industry has made so many contributions to production.

The TPS was presented to several Japanese companies and then, in the 1980s, it entered the West where it became known as Just in Time (JIT). However, it was the study of Womack & Jones (2004) which made the JIT popular in the West, where it became known as Lean Manufacturing (LM).

According to Christopher (2007), one of the key characteristics of the business environment is that competition takes place between supply chains and not just between organisations. Similarly, the elimination of waste, as also the effects of LM, does not occur only in one company, but rather in the whole network of companies.

Thus, this advancement of lean techniques for the whole network has become known as Lean Supply Chains – LSC.

Fisher (1997) says that, in a study of the American food industry, it is estimated that the poor co-ordination of the supply chain partners has led to losses of some 30 billion dollars per year. In many other industrial segments, the supply chain suffers from the excess of some products and the lack of others, due to the inability of forecasting demand. It is these losses that have led the organisations to pay attention to the implementation of lean network strategies.

2.3 Flexible Supply Chains (FSC)

The last few decades have been marked by an impressive rate of development of the markets. The appearance of new technologies and materials, as also the increase in income and in world demand, have generated an explosion of products and services, causing an enormous impact on the transformation industry.

Gong (2008) says that the manufacture companies, faced with keen competition, have developed a skill of dealing with internal and external doubts making use of flexibility. This is a target to be sought within the organisations.

The concept of flexibility, just like that of lean production, had the main publicity of its ideas in the Toyota Production System, as flexibility is an essential component of Just In Time. This came from the fact that the Japanese suffered from a scarcity of funds to produce, in the period after the Second World War. According to Costa Neto, Fusco & Reis (2009), the companies did not have enough capital to have the same quantities of machines and equipment as present in the mass production industrial firms in the West, meaning a need to introduce flexibility of productive activities.

According to Upton (1994), flexibility can be defined as the skill of introducing change or otherwise reacting with little loss of time. Fusco (2004) says that flexibility corresponds to “the state” of a company, a

set of capacities that are intrinsic to the company, to the results or the final potential of facing changes (whether planned or not) within a wide scope of meaning.

When we are talking about a network of companies, flexibility in operations is essential for the company to survive on the market. A supply chain must not be something unchangeable, and it is necessary that the company manages to introduce swift flexibilisation of operations, whether of production, logistics, marketing or supplies, which is made possible through the circulation of information at the different links of the chain. According to Vickery, Calantone & Droge (1999), the flexibility of supply chains can easily represent a potential source to improve the efficiency of the company, and is also a significant measurement of performance of the supply chain.

According to Vickery et al. (1999), Supply Chain Flexibility (SCF) can be defined as different types of flexibility which have a direct impact on companies and clients (flexibilities which add value, as regarded by the clients) and involve the sharing of responsibility of two or more functions along the Supply Chain, whether in internal functions (marketing, manufacturing) or external functions (suppliers, members of the distribution channel) of organisations.

Vickery et al. (1999) also analysed the dimensions of the SCF and their relationship within the environment of uncertainty, of performance in the business segment. The authors have defined five flexibilities for these networks: product, volume, introduction of new products, distribution and market responsivity.

2.4 Responsive Supply Chains (RSC)

According to Holweg (2005), "responsivity" is the ability to respond intentionally, and using an appropriate scale of time, to market demands and changes, thereby maintaining a competitive edge. Responsivity is a strategy that consists of their response time, which means that the shorter the response time of the network in catering to clients' needs, the more responsive the network shall be.

In this way, those organisations which compete in volatile markets and/or where the client is not willing to wait may obtain a sustainable competitive advantage through the reduction in the duration of their processes, be they productive, logistic, or for obtaining raw materials.

Thus, to establish a responsive strategy it is necessary to direct the company to the clients that are most attractive and most time-sensitive (Stalk & Hout, 1990). In this context, time-sensitivity is taken as referring to those markets where the clients are willing to pay a bit more to get their products in less time, or where the delay in making the items available leads to a loss of sales.

According to Christopher (2007), what allows a network to be more responsive is the use of the advantages of competition based on time, through the use of systems that are both responsive and fast.

Indeed, among all the paradigms of manufacture, we can infer that responsivity was the strategy which most rapidly evolved, in the case of the supply chain network, as a response based on time can only be obtained if the whole network is able to reduce its service times and the cost of the processes, in order to remain competitive in this segment.

Responsive networks combine the characteristics of flexibility to the conditions for response to the essential desires of the clients. Chase et al. (2006) established that responsive supply chains are chains that use strategies in order to be sensitive and flexible, in the light of the varied and dynamic needs of the clients.

Thus, if the supply chain complies with these two aspects while also responding to external directors, which means responding to the uncertainties of demand and the variability of products, reducing the processing time, it can be considered as a responsive supply chain, provided it controls the quality of the products and services that get to the consumer market.

2.5 Agile Supply Chains (ASC)

Agility is born in the manufacturing process, where it becomes responsible for agile manufacture (AM). Kidd (1994) says that agile manufacture can be considered a structure within which each company can

develop its own strategies for business and also for products, being supported by three core pillars: organisation, people and technology.

Agile manufacturing occurs when the company has the capacity of rapidly responding to the needs of the market (Ramesh & Devadasan, 2007). In markets where there is a continuous need for new products to meet the requirements of the clients, especially those in high-technology segments, AM comes about as an essential factor for the competitivity of organisations.

Power et al. (2001) say that the requirements so that the organisations may be more responsive to the needs of the clients, to changes in competition and to increases in the levels of turbulence within the business environment are the main guiding factors that have led these companies to adopt the concepts of agility in their business operations.

Martin Christopher, a British professor at the *Cranfield School of Management,* was one of the first people to introduce the concept of agility in the supply chain, in an article he wrote in the year 2000, "*The agile supply chain*" (Christopher, 2000), and also in his book "Logistics and Supply Chain Management" launched at the end of the 1990s (Christopher, 2007). These works were followed by a series of research studies which were published in several periodicals considered as of basic importance for the concept of the agile supply chain. These works are mentioned and also used by several researchers in a variety of periodicals, including, among others, the research studies conducted by Power et al. (2001), Ismail and Sharifi (2006), Ramesh & Devadasan (2007), Luo, Wu, Rosenberg and Barnes (2009), Wu and Barnes (2010).

According to Christopher (2000), agility is the skill of companies, which involves organisational structure, information systems, logistic processes and particularly knowledge management.

The idea of agility within the context of supply chain management focuses on the context of response to the market, being guided by demand, having the characteristic of a shorter lead time, based on information (Christopher, Lowson & Peck, 2004).

Ismail & Sharifi (2006) define an Agile Supply Chain (ASC) as a network with the capacity of all its members to quickly come into alignment, to respond to the dynamic and turbulent requirements of the network demand. Its main focus is on the structure of the business environment, which should have an appropriate level of agility to be able to respond to change, as also to proactively anticipate these changes and find new emerging opportunities.

Luo et al. (2009) and also Wu and Barnes (2010) both say that the ASC shall be highly flexible and skilful in quick reconfiguration, so as to respond to changes in the business environment.

2.6 Functional and Innovative Products

The strategies of the supply chains depend on the types of products and services that are commercialised, and also on the conditions of supply and demand.

Fisher (1997), the creator of the concept of functional and innovative products, says that the supply chains suffer with the excess of some products and the lack of others, through the inability of forecasting demand, and that an effective supply chain strategy is more than just considering the nature of demand for the company products, needing to consider many more aspects, such as: life cycle of the product; predictability of demand. Variety of products; standardization of the market in relation to service time (percentage of demand served with the products in stock).

Thus Fisher (1997) classifies the products, based on standards of demand, in two categories:

- **Functional products**: these are the products which satisfy basic needs of the consumer and which do not change much over time, having stable and predictable levels of demand and long life cycles. This stability generates competition, which in turn leads to low profit margins.
- **Innovative products**: these are the products which, through innovation and technology, become popular at certain times and generate, for the consumer, an additional attraction to buy these

products. This leads to an increase in profit margins. However, the demand for these products is unpredictable, the life cycle is short (only a few months) and they suffer from imitations of other companies, which reduce or even eliminate the original competitive edge, making the company live in cycles of innovations.

Fisher (1997) says that innovative products, due to their characteristics, require supply chain strategies that are different from those of products considered functional. Thus, this author explains that, to understand the performance differences between these networks, they shall be analysed based on physical functions and also on marketing.

The physical function includes the conversion of raw materials into spare parts, components and finished products, as also the transport of all this to a point in the network. Less visible, the marketing function has the main purpose of making sure that the variety of products reaches the consumer market. Both these involve costs, one in costs for production, transport and storage, and the other inn costs for excess products or costs of loss of sales through lack of stock.

Also according to Fisher (1997), for a company to create an ideal supply chain strategy it should:

1. Establish if their products are functional or innovative: even though this could be done by the managers based on the products with unstable and stable demand (Table 1);
2. Establish if the network is efficient or responsive to the market;
3. Prepare the ideal strategy for the supply chain.

Table 1: Functional versus Innovative Products.

Features	Functional	Innovative
Aspects of demand	Predictable	Unpredictable
Product life cycle	More than 2 years	3 months to 1 year
Contribution margin	5% a 20%	20% a 60%
Product variety	Low (10 to 20 variants per category)	High (often millions of variants per category)
Average margin of error in the forecast at the time production is committed	10%	40% to 100%
Average stockout rate	1% to 2%	10% to 40%
Average forced end-of-season markdown as percentage of full price	0%	10% to 25%
Lead time required for made-to-order products	6 months to 1 year	1 day to 2 weeks

Source: Adapted from Fisher 1997

The functional products have predictable demand, generate a larger life cycle, with low variety which makes the productive process easier, as well as managing to eliminate the reductions in prices at the end of the season, all the more because the products are generally not quite so seasonal. However, their margin of contribution is small.

Innovative products, even though their demand is volatile and highly variable, have a greater contribution that would justify these losses. These products have a high risk of being lost through obsolescence due to the lack of demand, as well as having a high rate related to lack of stock.

After the work of Fisher (1997), Lee (2000) presents a study on the uncertainties of demand and supply related to the supply chain strategies and also the types of products (Figure 2). Later on, authors such as Chase et al. (2006) and Corrêa (2010) gave great prominence to this contribution.

		Demand Uncertainty	
		Low (Functional Products)	**High (Innovative Products)**
Supply Uncertainty	**Low (Stable Process)**	Grocery, basic apparel, food, oil and gas **Efficient or Lean Supply Chains**	Fashion apparel, computers, pop music **Responsive Supply Chains**
	High (Evolving Process)	Hydro-electric power, some food produce **Risk-Hedging or Flexible Supply Chains**	Telecom, high-end computers, semiconductors **Agile Supply Chains**

Figure 2: Uncertainties and Supply Chains Strategies. Source: Adapted from Lee (2002) and Chase et al. (2006).

According to the model as proposed by Lee (2002), the supply chains are divided into four types: lean or efficient supply chains, here in this work called lean supply chains; responsive supply chains, here known as responsive supply chains; supply chains with minimum or flexible risk, treated as flexible supply chains; and agile supply chains, for which the denomination of agile supply chains shall be used.

The matrix shows some products classified based on the type of supply chain strategy to be used and also the uncertainties of supply and demand. Thus, if the uncertainty of supply is high and the uncertainty of demand is also high, then there is a need for greater agility in the process and also the recommendation is for the use of an agile supply chain. This same line of reasoning is used for the other combinations.

3 Methodology

The methodology of this work has sought to describe a way of identifying the correct supply chain strategy to be applied to organisations. Thus, by using some simple steps it is possible to identify the correct strategy in a company which is to be analysed.

1. The first step is an analysis of the organisation, collecting data about the processes. This survey is conducted in three different ways: interviews with managers, on-site visits for the analysis of operations, and also the survey of accounting and administrative documents. The important thing here is that the data collected allow the identification of the necessary information for the classification of the company and also the definition of strategies to be adopted.
2. In possession of the data as collected, the next step is that of seeing if the products of the organisation are innovative or functional. It is important to stress that a company with innovative and functional products in its product portfolio shall need to use different strategies for these types of products, to maximise gain. However, there is nothing to prevent a company from using an appropriate strategy in the products that bring greatest gain, be they functional or innovative, with the organisation being responsible for the definition thereof.
3. Once it has been identified whether the products are functional or innovative, and also analysing the data obtained, it is then possible to identify, within a matrix, the most appropriate supply chain strategy for the operations of the organisation as here considered.

4. Once this stage has been finalized, the company already identifies what supply chain strategy can be applied to the network, but on the other hand to define to what extent the current chain is flexible, lean, agile or responsive it is necessary to carry out additional studies like that proposed by Reis and Costa Neto (2011).

4 Discussion and Results

To demonstrate the application of the methodology, among all studies carried out, the choice made was that of a demonstration in a steel-producing industrial unit belonging to a business conglomerate which is active in four different segments: mining, steel, steel transformation and capital goods.

This steel-producing unit has two industrial plants in the Southeast of the country. The study was based in one of these units, where a total of 5,100 collaborators work, with an installed capacity of approximately 9.5 million tonnes per year.

The unit studied produces thick steel sheet and coils (both heat-laminated and cold laminated). The data was collected in the second half of 2011, in three different ways: interviews with managers, on-site visits to the premises to see how the operation is carried out, and also an analysis of the last management report. Table 2 identifies the type of product of the company based on the data obtained. For this purpose, an adaptation was made of the work of Fisher (1997), so as to allow each characteristic as researched to be classified in one of the two columns of Table 2.

Table 2: Establishment of Type of Product at a Steel Production Unit.

Item	Features	Functional Products		Innovative Products	
1	**Aspects of demand**	Predictable	**X**	Unpredictable	
2	**Product life cycle**	More than 2 years	**X**	Up to 2 yeas	
3	**Contribution margin**	Up to 20%		More than 20%	**X**
4	**Product variety**	Low (10 to 20 variants per category)		High (often millions of variants per category)	**X**
5	**Average margin of error in the forecast at the time production is committed**	Up to 10%	**X**	More than 10%	
6	**Average stockout rate**	Up to 2%	**X**	More than 2%	
7	**Average forced end-of-season markdown as percentage of full price**	Up to 10%	**-**	More Than 10%	**-**
8	**Lead time required for made-to-order products**	3 weeks or more	**X**	Up to 2 weeks	

Source: Author.

The demand of the products is predictable over time, which can be confirmed by looking at the variation in consumption of these materials over the last few years. The product life cycle can vary, but there are some kinds of steel that are more than 100 years old.

The margin of contribution, which is the sale value less variable costs and overheads, divided by total sales, has not been directly identified. Thus, we made an estimate based on the cost of the products sold and also the overheads in steel production in general. For this, we based ourselves on the annual report of 2010 and also the establishment of variable costs estimated by the company at between 80 and 85% of total costs.

Thus, the margin of contribution came to about 24% with a tendency to be a characteristic of an innovative product. The variety of steels that have an influence on the product comes to about 180 different types. The products may also have different technical characteristics, such as roughness, thickness and length, which increase this degree of variability even further. Thus, this item also has the characteristics of an innovative product.

The average number of prediction errors came to 200 parts per million, which corresponds to 0.2$ between the demand and the volume produced. The rate of lack of stock was considered to be 0% by the company. This can be explained by the fact that raw materials go directly to the plant by rail and also by ships that dock directly at the unit. In addition, raw materials come in every day, and the manufactured products follow the clients' specifications, which means that the products that are being laminated, for example, are produced according to the client's order and specifications.

It also needs to be considered that the use of a continuous and computerised form of production planning and control reduces the risk of lack or excess of materials in stock. Also in relation to this issue, one must stress that the continuous production of the furnaces brings a requirement that there be no lack of raw materials for production, lest there be an increase in costs.

The reduction in price at the end of the period has not been identified, as currently it depends on the competition within this segment over the period. As the segment is highly fragmented, competition establishes the end price to the clients.

Regarding the processing of a product to order, from the start of the process at the steel smelting unit through to delivery, this takes an average of 45 days for cold coils, which is considered by the company to be an excellent time frame.

We therefore conclude that the product of the company is functional and not innovative, based on criteria as previously established that determine the type of product, when one column or another of Table 2 contains more than five affirmative answers.

Later, to establish what kind of strategy concerning supply chains is best suited to the type of product of the company, the data is shown in the matrix of Figure 3.

		Demand Uncertainty	
		Low (Functional Products)	**High (Innovative Products)**
Supply Uncertainty	**Low (Stable Process)**	**Lean Supply Chain**	**Responsive Supply Chain**
		X	
	High (Evolving Process)	**Flexible Supply Chain**	**Agile Supply Chain**

Figure 3: Supply chain strategy. Source: Author.

The products considered functional and with low uncertainty of demand and similarly low uncertainty of supply may be included in the group of commodities.

Also along this line, Christopher (2007) says that commodities are products that are the same from the consumer's standpoint. Thus, a consumer who purchases DVD recording equipment and cannot distinguish it from other similar equipment, considering only the cost of the product and probably the quality, is facing a product that can be considered a commodity.

Through the observations as here made, where the uncertainty of supply is low and the uncertainty of demand is also low (functional products), we understand that the best strategy is that of a lean supply chain, as quality is an important factor for the company and the product competes based on cost. Thus, any waste within the chain may lead to a loss of competitivity of the company and even the company's demise.

5 Conclusion

This work has presented different types of supply chain strategies and also a methodology so that organisations can identify the strategy which is most appropriate for the kind of product. To demonstrate this methodology, a study of a steel-producing company is here presented. The results have shown that the products were functional and therefore the most appropriate strategy for this business segment would be that of a lean supply chain.

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