

ESTABLISHING COLLABORATIVE PROCESS MODEL IN THE SUPPLY CHAIN

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***Abstract.** In order to achieve the competitive advantage against other organizations, it has been sought a new business model that enhance the most of mutual benefit between suppliers, manufacturers, distributors and retailers, offering better service to customers. The increase of benefits can be obtained through reduction costs, increase of innovation capacity and reducing the takt time of new products and services. Efficiency and effectiveness can be achieved by the companies considering the up-stream and down-stream members of the supply chain as co-workers who have the capabilities to achieve the objectives of the chain (Cousins and Menguc, 2005). The concept of collaborative networks links customers and suppliers in order to increase added value and allow that supply chain becomes more effective compared to the traditional methods used by the organizations (Confessore, Galiano and Stecca, 2006). According to the presented context, this paper proposes the introduction of collaborative processes in the supply chain. It establishes the collaborative process and its development, benefits and barriers of collaboration and its measure performance in relationship to the traditional processes.*

Keywords: Collaborative process; supply chain; collaboration's benefit.

1. INTRODUCTION

Over the last decades, business environments have been changing from mass-production to customization and from technology and product-driven to market and customer-driven. Providing distinctive customer values has become one of the main business drivers for companies. These changes, caused by globalization, provides greater access to new technologies, enables a demographic approach and greater participation in the global economy.

In this emerging competitive environment, the ultimate success of the single business will depend on management's ability to integrate the company's intricate network of business relationships.

The development of the supply chain as a strategy for competitiveness showed that the efficiency and effectiveness brought by the concept of collaborative process could generate direct (cost reduction) and indirect (improving the performance of delivery, technology acquisition, etc.) improvements for participating companies (Confessore G., Galiano G., and Stecca G.A., 2006). In attempt to achieve the mentioned benefits, companies have adopted better manufacturing practices and transposed their limits, aligning their internal and external processes, from suppliers to consumers.

The alignment of internal and external supply chain processes indicates the degree of cooperation (integrated supply chain) and collaboration (collaborative supply chain) between the organizations involved. The adoption of these practices results in greater benefits for companies, which were not achieved through the traditional supply chain.

Forward to this new world economic outlook, the purpose of this article is to present the concept of collaborative process in the supply chain, reflecting on the following questions: How to introduce the collaboration process in the supply chain? How is the collaboration process in the supply chain? What are the major issues that impact this process of collaboration? What are the evidences that are or may be involved in this process? What are the advantages in relation to the traditional process of supply chain management? What are or could be the performance indicators to measure the process of collaboration in the chain?.

2. SUPPLY CHAIN

According to La Londe and Masters (1994), a supply chain is a set of firms which pass materials forward. Normally, several independent firms are involved in manufacturing a product and placing it in the market in a supply chain—raw material and component producers, product assemblers, wholesalers, retailer merchants and transportation companies are all members of a supply chain. Trent (2004) complements the previous concept stating that a supply chain is a set of organizations directly involved, where there are flows (upstream and downstream of the chain) of products, services, finance and information.

The Global Supply Chain Forum (GSCF) defines the Supply Chain Management (SCM) as an integration of key business (processes from end user through original suppliers that provides products, services, and information) that add value for customers and other stakeholders.

The result of the management and integration of the supply chain is an increase of the added value in the chain due to the evolution of management activities and the integration of processes, whose benefits are indirectly reflected in the

final product. The forecast of demand, the planning of production and replenish in the chain is a joint decision of all links in the supply chain (Bertaglia P. R., 2003), ensuring mutual benefits that encourage participation in the chain.

Actually this rarely happens because of the local vision and opportunities of participating members, which therefore, commit errors of forecasting which comit the profitability of the chain.

Estimate errors of demand are critical to the supply chain as a whole; they end up being more costly than the production itself, especially for the chain where the product life cycle is short. According to Simatupang and Sridharan (2002), the main problems caused by errors in estimates of demand are the costs for lack of inventories, the necessity of create promotions, transshipment problems, costs of publicity and sales, costs of excessive inventories, obsolescence, etc. Pressed by the market expansion, enterprises are forced to reassess the efficiency of their supply chains.

Constantly, growing cycles which go from concept to launch, and life cycles of products are demanding high flexibility and agility of supply chains as never before. The solution found by the organizations has been intense focused on its partners to improve the capacity of the supply chain. Collaboration and cooperation of partners in the supply chain to obtain more accurate forecasts and plans are as a revolution in supply chain management.

2.1. Integrated Supply Chain

In the context of the traditional supply chain each node develops strategies to achieve their own goals, or maximize your profitability, without considering the optimization of global supply chain. The consequences of this local view is reflected in problems such as uncertainty of the information transmitted between the companies of the chain, characterized by the distortion of demand (Bullwhip effect or effect the whip) in each stage of the production; high levels of inventory; inadequate transport. Emerging as a proposed solution, one has: the integration of supply chain, in order to improve the quality, simplify the information flow and reduce inventories and costs.

Among the major contributions on the integration of supply chain there is the model presented by Stevens (1989), divided into four phases: the basis, the functional integration, the internal integration and external integration. This model was extended by Hewitt (1994) considering an additional step, aiming the improvement of the administration and planning of business processes. The model is shown in Figure 1.

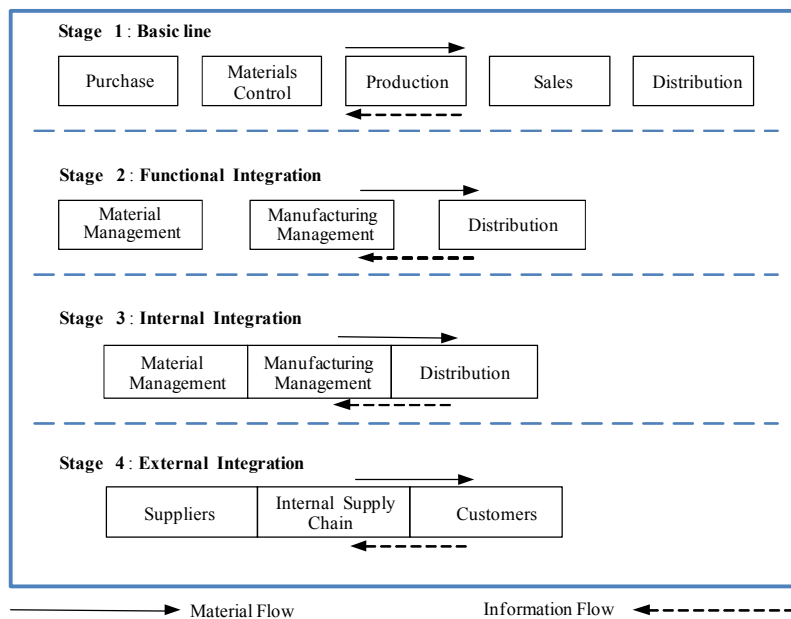


Figure 1. The Integration of supply chain
 Source: Hewitt (1994)

Towill et al. (1992) presented an approach of integration similar to that of Stevens (1989) and based on principles of management of operations to reduce the amplification of signal along the demand chain. Bowersox (1996) established two types of integration: the internal and external, suggesting that the creation of benefits for time and location in the chain requires sharing information, creating profitable trade agreements, and creating an appropriate environment for financial transactions.

By Ortiz et al. (1999), the focus of integration within an organization aims to join the internal business processes (intra-processes) and external business processes (inter-processes) with its trading partners. The integrated company aligns its strategy and its operational effectiveness with the intention of achieving their goals. In summary, we integrate strategies, processes, people and technological companies. A fully integrated system complies with the following:

- a. The specifications and requirements of each company are known only by those that make up the system.
- b. Companies contribute to the achievement of common tasks.
- c. The companies share the same definition of each of the concepts shared.
- d. Companies seek to balance those critical factors to the proper execution of their processes.

To achieve a high level of integration in the supply chain, one requires a large amount of resources, extensive changes in the organization, high degree of trust between partners, and sophisticated infrastructure. Thus, when the supply chain achieves integration also is capable to develop cooperation within the chain.

3. THE COLLABORATION IN THE SUPPLY CHAIN

Enterprises are looking toward collaboration as an opportunity to optimize their supply chain and relationships with their trading partners. Supply chain collaboration occurs when two or more companies share the responsibility of exchanging common planning, management, execution, and performance measurement information. By Barratt (2004) the main objective of the collaboration is working with partners in the search for mutual benefit, and to achieve these results, it is required some essential elements of both partners as trust, reciprocity, interdependence, flexibility, mutuality and commitment, and physical elements such as joint actions, shares data in general, among others, ensuring the exchange of synergy between the partners during the collaboration. However, the traditional supply chain cannot adapt to new consumer trends, which demand products and services customized, high quality and rapid delivery at low cost, requiring that the chain determine ways to improve customer satisfaction and consequently increase its global competitiveness.

Supply chain collaboration possesses complex challenges to supply chain partners, in which there is a broad spectrum of collaborative initiatives, disparate standards for communication, and various levels of trading partner competencies and business processes. By Wenli and Bay (2005) in addition to increasing the cooperation between the members the process of collaborative supply chain provides other benefits such as increased profitability, reduced operational costs and greater flexibility to deal with the high uncertainty of the market, yet there is another stimulus to divide their resources and skills, that is the ability to exploit profitable opportunities which could not be performed by a single company.

The benefits of collaboration can be noted in the short, medium and long-term supply chain. Some of these benefits are short-term: emerge capacity planning, inventory reduction, reduced length of application services, increased capacity and increased use cash flow; medium-term: increasing the mix of products, increasing the effective life cycle of products, decreasing time to market and increased flexibility; long-term: increasing market share, increased level of customer service and reducing the overall costs.

For Wenli and Bay (2005) the adoption of the collaboration is evolutive and it is necessary to pass through stages as traditional supply chain, integrated supply chain to achieve the collaborative supply chain. The collaboration in the supply chain has been presented in various forms, but always with the same goal of creating a visible and transparent estimate of demand for all members of the chain. Although there is a great advance on the theoretical Collaborative Supply Chain, in practice its implementation faces a number of obstacles, because enterprises can be part of different configurations; can be a node in a supply chain; or a node that belongs to different chains and networks; may be part of a virtual supply chain, which is designed to satisfy the customer, or a specific demand.

To Simatupang and Sridharan (2006) and Barratt (2004) there are some forms of collaboration and these are divided into two main categories, vertical and horizontal.

The vertical collaboration occurs when two or more organizations, such as producers, distributors, carriers and retailers divide responsibilities, resources and information on their performance to better serve end customers. Some resources used in vertical cooperation both upstream and downstream of the chain are: Vendor Managed Inventory-VMI, Efficient Consumer Response-ECR, Collaborative Planning, Forecasting and Replenishment-CPFR.

The horizontal collaboration occurs when two or more independent organizations cooperate in a competitive way sharing their private information, capacity, etc.

This article focused specifically in the vertical cooperation where there are several possibilities for collaboration, as shown in Fig.2, which distinguishes the opportunities for collaboration both upstream and downstream of the chain.

It is important to understand that collaboration goes beyond the exchange of information on the level of operational activity. It should be extended to tactical and strategic levels of supply chain organizations not to limit the collaboration benefits. For Trent (2004) it is clear that the competitiveness of the supply chain is closely related to the creation and maintenance of relationships established in the chain, but this does not mean that every relationship should be seen as special or unique. Different types of relationships require different types of care as information and the division of collaboration. The degree of collaboration which must be exercised with every organization is the amount of added value to the product chain. This concept can be applied in both upstream and downstream chain members, i.e. for suppliers and customers. As can be seen in Fig. 3, the type of relationship to be established with suppliers is defined through the classification of added value of the chain product versus the amount of qualified suppliers (Trent, 2004).

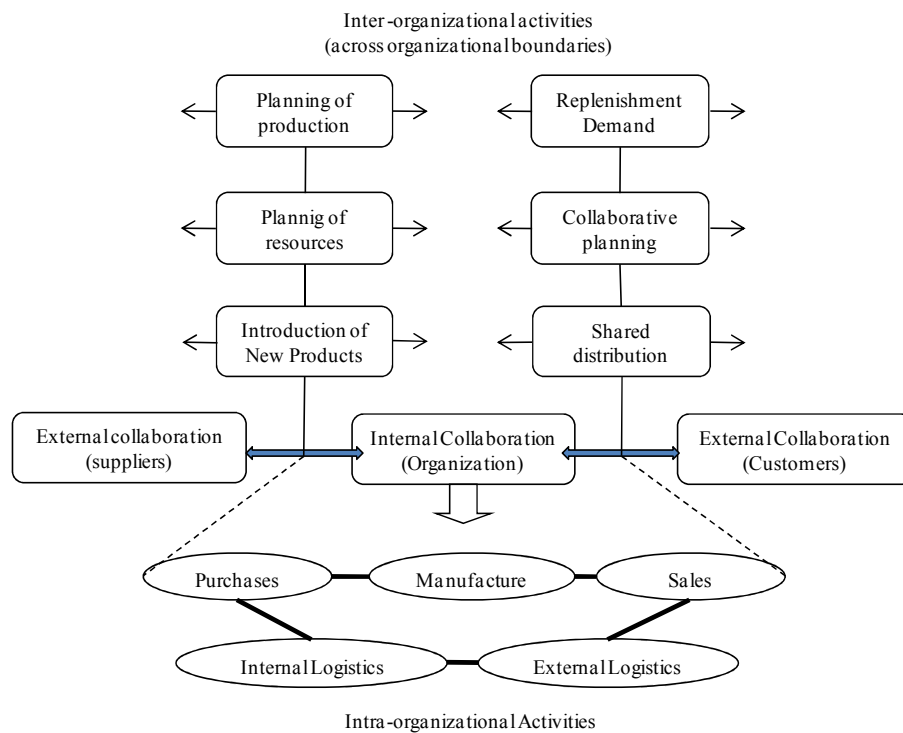


Figure 2. Scope of vertical collaboration

Goods and services located in the quadrant of transaction items contribute with low value and there are few capable suppliers, i.e. there is a limited offer. The creation of value occurs through negotiation of the purchase cost of items; and the type of relationship which is to be established with these suppliers has to be the traditional one, becoming possible to search and compare prices with other suppliers.

The quadrant of market items present low added value. Items and services are characterized for their many suppliers and low costs to change the suppliers; they are acquired through bidding and auction. The objective of the relationship with the suppliers of these items is to establish a competitive price. By Trent (2004), the establishment of a high level of relationship in this situation would be unproductive because the costs of the relationship exceed the benefits.

The quadrant of leverage items is characterized by items and services that benefit the consolidation of volume; long-term contracts are established and the negotiations should be considered factors which will affect the performance of the chain, such as cost, quality, delivery, packaging, logistics, inventory, etc. Here the concern is with the full cost rather than with the price, and relations with suppliers of leverage items should be at least cooperative.

In the quadrant of strategic items are those vital to the function of the product or that which help to distinguish the product in a valued way by the final consumer. These goods and services involve customization rather than standardization, and consequently there are fewer capable suppliers to meet the needs of the buyer. Although the strategic items represent a small part in the final product, they have strong impact on price and performance. In this case, the collaboration should be seen as the way of adding value to the product.

As mentioned, the same analysis realized for the suppliers can be performed for consumers, since consumers buy different products, have different expectations of service level and are disposed to pay prices that match their service level requirements. The consumers should be segmented by their behavior and service necessity. The strategy to be adopted by the supply chain also depends on the customers segment that it intends to take, in some cases it should be collaborative (Trent, 2004).

The adoption of the collaboration strategy is not easy and requires that companies in the supply chain develop a strong base of collaboration culture, which consists of a number of factors: trust, mutuality, openness of exchange information and communication.

There is consensus in the literature that internal and external trusts contribute significantly to long-term stability in a chain. The coordination of the supply chain is based on trust and commitment. The reciprocity refers to mutual benefits achieved by participants in the supply chain, it is important that respect and sharing of risk be also considered in order to have a relationship win / win between partners. The exchange of information is widely studied and the conclusions are unanimous on the importance of sharing, quality and transparency of information flow to the performance of the supply chain. By Trent (2004), in recent decade, advances in information technology contributed to the agility of the supply chain and effective sharing of data between suppliers, manufacturers and consumers, beyond creating a virtual supply chain, i.e. supply chains which make decisions based on information rather than inventory.

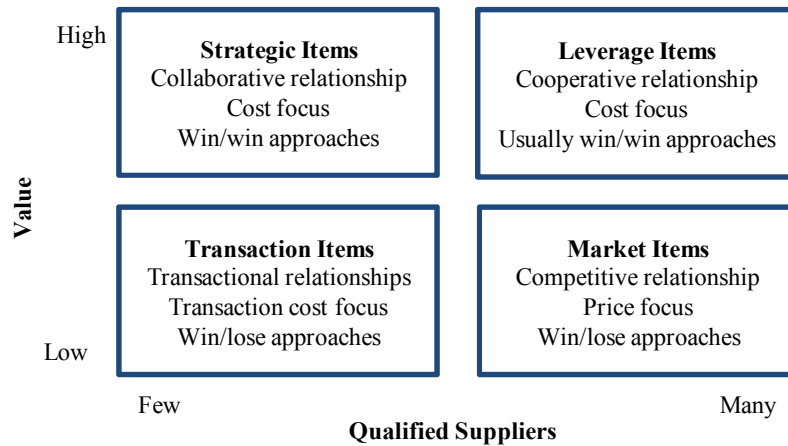


Figure 3. Approaches and Relationships in the Supply Chain (suppliers)
 Source: Trent (2004)

3.1. Information and Communication Technology

The growth and development of information and communication technologies (ICTs) has led to their wide diffusion and application, thus increasing their economic and social impact. The evolution of Information and Communication Technology (ICT) has followed a parallel path to the current organization that is developed in business. The coincidence of this fact follows a condition of reciprocity between technological changes which enable the organizational changes. The adoption of ICT is spreading rapidly in supply chain management. As companies seek to improve supply chain efficiency through increased integration, ICT can be considered as a key enabler for supply chain management by supporting information-sharing. By Radjou (2003) the use of information technology (IT) in managing the supply chain process has increasingly benefits like: improve supply chain agility, reduce cycle time, achieve higher efficiency, and deliver products to customers in a timely manner.

The advancement of ICT in the supply chain communication system (SCCS) can help to build stronger supply chain capabilities in several ways. First, by Booth & Philip (1998), Clemons & Row (1993) and Malone et al.(1987), the equipment of advanced SCCS has the potential to enhance the speed, quality and quantity of information transferred; second, for Clemons and Row (1993), the deployment of an advanced information technology in the supply chain system can achieve better coordination and reduce transaction costs between partners; third, by Bowersox et al. (1999) an advanced SCCS can also improve inter-firm integration between channel partners.

4. PERFORMANCE INDICATOR

In the common organizational culture, the approach which has prevailed for years to measure the performance of companies was based on quantitative results related to the historical and financial information, thereby generating a restricted vision to find new sources to add value to businesses. In this context and with the emerging concept of collaborative supply chain as a new focus of the production system, competition between organizations has been a particular problem but now it started being a problem of all company members of the chain, causing a change in the performance measurement from a mono-dimensional to a multidimensional vision.

Several authors have established various key indicators to monitor the performance of traditional supply chain developing different classifications and establishing the same basic types that allow a better use, but there are few studies addressed to the management of the overall performance of collaborative supply chain.

In literature the classification of traditional indicators may be focused on three groups: that based on relevant individual measurements; that which covers the different aspects of supply chain management; and that which try to measure the overall performance of the chain. However, to Gunasekaran et al. (2001), the work that creates systems or structures to define indicators to measure the overall performance of the supply chain, have two major weaknesses:

- a. The lack of a balanced approach (e.g. financial measures versus operational measures), or unbalance in the decision of the number of measurements to use.
- b. The lack of a clear distinction between some measurements as strategic, tactical and operational.

In this sense, the author seeks to minimize these problems by drawing a mark that ranks the indicators in these levels (strategic, tactical and operational), according to the function which develops their characteristic, for example, financial or non financial. For the collaborative supply chain, according to Hausman (2003), are necessary rescheduling, selecting and deploying new external measurements, whose changes will be made not only in terms of performance, but also in all the major practices of the business. The wide adoption of collaborative supply chain requires that the instruments allow to measure internal levels and the relative levels of collaborative practices (Trent, 2004).

In attempt to develop scales for assessing the performance of collaborative supply chain, Simatupang and Sridhran (2002) proposed a tool, the "Collaboration Index" to measure the extent of collaboration in the chain. The proposed model incorporates collaborative practices to share the information, to synchronize decisions and to align incentives. The sharing of information refers to the act of capturing and disseminating timely and relevantly information for planning and controlling operations of the supply chain. Synchronization refers to the joint decision for the decision-making in the context of operational planning. Finally, the alignment of incentives is extended to that chain members which share costs, risks and benefits. The three dimensions are important to enable greater participation of members of the chain to improve the product flow speed to consumers. Table 1 shows the performance measurements to the extent of sharing of information.

Table 1. Measurements for the dimension of sharing of information

Dimensions	Performance measures
Sharing of Information	Promotional events
	Forecast demand
	Data points of sale (POS)
	Price of changes
	Cost of inventories
	Policy of inventories
	Interruptions in supply
	State of order
	Delivery schedules

Source: Adapted to Simatupang and Sridhran (2002)

5. METHODOLOGY

This research was conducted through literature search, which theoretically discusses the collaborative process within the supply chain and proposes a sequence of process to help structuring the implementation of collaboration in the chain. We believe that companies that make up the supply chain and be able to focus on overall objectives of the chain bring benefits to all members, whereas the search for improvements that involve only internal areas of the organization are no longer sufficient to maintain the competitiveness of the chain within the new organizational and economic context. There is a consensus in literature that external collaboration with suppliers and customers is a key factor for successful global supply chain.

There are some factors that contribute to the success of the collaboration, among them can be mentioned the choice of partners, choice of project manager, project management, assuring equilibrium in the supply chain, monitoring of environment influences and implementation of benchmarking. The suggested process to support the implementation of collaboration in the supply chain is composed of five steps. The first, opened in the target market, defines the type of customer that the supply chain aims to meet; the second should measure the degree of relationship with end consumers; the third defines the degree of relationship with suppliers in the supply chain members. After identifying the market segment being served by the supply chain and to define the degree of relationship with suppliers capable of providing greater added value to the product in the eyes of the end consumer, the next step is to establish strategies consistent with the goals and targets previously established by the chain, to the development of a set of appropriate measurements for collaboration to enable the monitoring of the performance and help the development of the collaborative process chain. Figure 4 shows the layout of the process suggested above and then explains the steps mentioned.

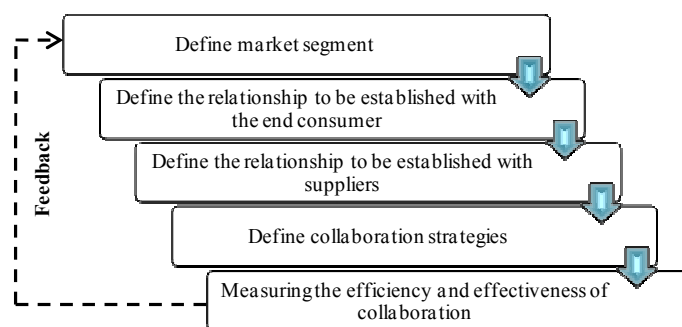


Figure 4. Support processes to the implementation of the collaborative supply chain

Step 1: Definition of the market segment: Companies belonging to the supply chain should take into account that one cannot act globally, offering the same products to all segments of the market which wants to achieve, because each segment has customers with different expectations. This does not necessarily mean that there must be radical changes in products, but rather seek a new balance between the attributes of products and market segment you want to achieve, namely to emphasize the characteristics that attract a certain segment (TOBON et. al., 2004). The probability of success of companies that do not define your market segment is minimal and companies trying to reach all segments do not meet any. After defining the market segment it must be set the target market, which is composed by potential consumers of the product.

Step 2: Set the relationship to be established with the consumer: From the model of the Relationships Supply Chain to suppliers matrix (Trent, 2004) it will be drawn an array of relationships in the chain to indicate to customers that the chain must maintain the strategy of cooperation, as shown in Fig. 5.

The classification was based on the purchasing power of customers (low and high) and the kind of product that consumers are inclined to buy (commodities or innovative). The matrix was prepared for those types of products demanded by consumers (convenience items, purchase items, specialized items and substitute items); for a feature found in the consumer product (differentiation, functionality and necessity); and for the orientation of the consumer at the time of choosing the product (price and service level). The four types of products demanded by consumers are described below:

1. **Convenience Items-** Refers to goods and services purchased frequently, involving a minimum effort. Milk, sugar, bread, electronic components, etc. are items purchased by impulse, purchased for maintenance of stock and purchased in an emergency situation. As consumers often buy this type of product, it is important to make this trade as convenient as possible and enhance the visibility (among others, the location).
2. **Purchase Items-**This type of product is purchased after comparison of product characteristics (price, quality, style, etc). Clothes, electronic products and insurance are some examples of such products. Before purchasing there is a lack of information, which is satisfied after the act of acquisition. It becomes important characteristics the physical attributes, guarantees, after-sales service, point of sale, price, name and reputation of the store. The marketing effort has an important role in sales. The marks do not provide much differentiation. The marketing attempts to emphasize the price or to do the potential customer aware of less obvious features that contribute to the quality, attractiveness, etc.
3. **Specialized Items-** They have unique characteristics, high prices and are associated with known brands. The potential clients know exactly what they want and are inclined to "pay the price." They begin the process of purchasing with full information of the product and refuse substitutes. Customers want to exert considerable effort to get the products, so the marketing needs a few outlets. High personalization and advertising generated to the image of the product are the focus of marketing. In this case, the relationship found in the supply chain should be cooperative. Therefore, innovative products have volatile demand and require high degree of differentiation. Consumers who buy such products seek high level of service.
4. **Items Substitutes-** Have the same functions of specialized items and the customers consume as an alternative to innovative products. They have more affordable prices because the product is not associated with the brand, moreover they have similar quality to specialized items. In this case, the relationship established in the downstream of the supply chain should also be collaborative because it has the same characteristics of the specialized items. So, the consumers who acquire this kind of product search also for high level services.

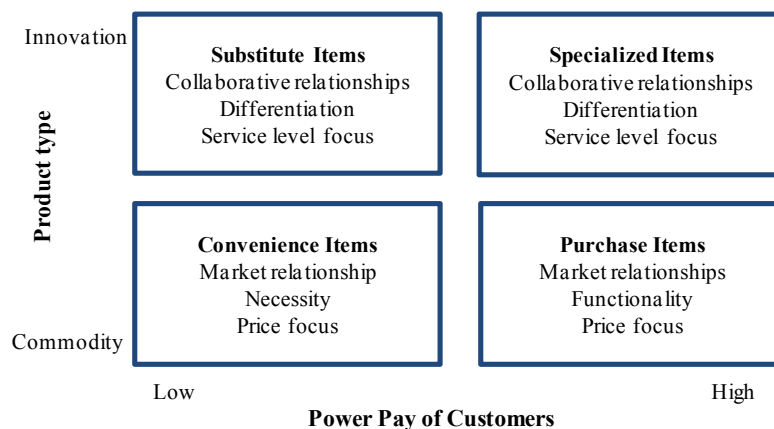


Figure 5. Approaches and Relationships in the Supply Chain (customers)

Step 3: Define the Relationship with Suppliers: According to Trent (2004), the relationship with suppliers is established according to the importance of the provided items. Therefore, cooperation should not be established with all providers of supply chain. According to Fig. 3, the cooperation should be established only with suppliers that provide

products for strategic items in the chain, i.e. items or services that differentiate and add value to the product in the point of view of the end consumer.

Step 4: Definition of Strategies- After defining the kind of customer who the supply chain wants to attend and identifying the type of relationship to be established, it is necessary to define the strategies that will be used to ensure a high level of performance in collaborative supply chain.

One of the strategies to be defined is the process of manufacturing operation to be established based on the product to be supplied. The process of manufacturing is classified under the following model (Taylor, 2006):

a. MTS - Make to Stock: This model is applied to markets which have stable demand, such as commodities. It is based on forecast demand, but the changes in consumer behavior have made difficult the process of forecasting. In order to reduce the cost of inventories and the obsolescence of products, companies are changing their manufacturing processes to other models, as Make to Stock. The strategy of production that should be adopted is of the system-push.

b. MTO - Make to Order: This model is applied to markets with unpredictable demand and the customer wants to wait for delivery of the product as the it is finalized in accordance with the specification of the customer's request. The assembly under request is considered winner of the market, since it provides high flexibility of the chain, either by volume, customization and time of delivery. The strategy to be adopted is of the system-pull.

c. ATO - Assembly to Order: Part of the production process is based on the forecast. Before the customization the products follow a pattern. Since the request of the consumer is received, the product is assembled in accordance with the specifications. The strategy that allows a limit between standardization and customization is the Border Push-Pull, or this is a hybrid system composed of the MTS and MTO systems.

A management strategy that should also be emphasized is the development of the four elements of the collaborative culture, previously mentioned.

Step 5: Measuring the Efficiency and Effectiveness of Collaboration: The models developed for the assessment of business performance help companies in a supply chain to implement strategies and monitor the performance of the efforts made in conjunction with partners, thus achieving the objectives formulated. As the culture of collaboration is not easily implemented in most companies, the measurements of performance also makes possible the understanding of the benefits of true collaboration and justify all the work and effort made by members of the chain.

According to the benefits achieved by the collaborative supply chain it will be established indicators able to monitor the success of its development. Table 2 shows the relationship between some benefits and the proposed measurements to monitor the development of collaborative supply chain.

Table 2. Measurements of the collaboration benefits

Benefits	Measurements
Inventory reduction	Reduction of end product inventories
Increase of cash flow	Increase of the effectiveness of promotions to consumers
Reduction of the time to market	Reduction of the number of days which are necessary to generate the request after the requiring
Reduction of the global cost	Reduction of the distribution costs
Increase of flexibility	Ability of changing the level of output of the end products

6. CASE STUDY

In last twenty years, many countries have been promoting structural reforms in the natural gas industry, seeking for efficiency and economic rationality through the introduction of competition in certain steps in the chain. In Brazil, the activities of exploration, exploitation, storage and transportation of natural gas (called upstream) were the Petrobrás monopoly until 1997. Inspired in the process of reforms in countries like the United States, England and Canada, the government promulgated the Law 9478/97, removing the legal monopoly of the company with the aim of promoting investment and competition in the sector. Past 12 years, little progress has been achieved in this direction. Petrobrás and its subsidiaries continue dominating the upstream activities, which also controls majority or fully, the distribution and commercialization to consumers (downstream activities) in almost all federal states. In State of São Paulo the monopoly of the sale for final consumers will be broken in 2011, (Sant'Ana, 2008).

According to Sant'Ana, the natural gas industry in Brazil is not yet as mature as that of electricity. For this author, Brazil should create flexibility mechanisms of supply and demand as was developed in the United States and United Kingdom in the 1980s. Considering this scenery of natural gas, is relevant to conduct the case study of the natural gas supply chain in the State of São Paulo in order to analyze the implementation of collaboration process.

6.1 Natural Gas Supply Chain

The structure of the natural gas supply chain is showed in Fig.6. This is composed of five links: reserves, production, importation, transportation, distribution and storage and end consumer.

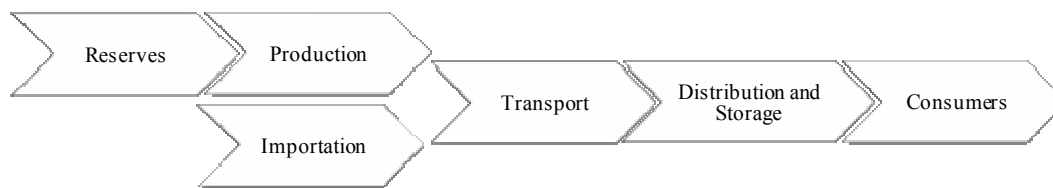


Figure 6. Natural Gas Supply Chain

Reservations: The identification of natural gas reserves requires a large investment with an associated risk of the exploration activity. In this stage are realized technical and commercial viability studies in the natural deposits. After identifying the feasibility of the natural gas commercialization, projects of necessary installations to commercial explore of the natural deposit are realized, including drilling activities, the range of activities to equip the deposits and provide a safe operational process and minimize environmental risks.

Production and Imports: The production of natural gas consists in its extraction and separation of other substances; it is composed primarily of methane (in the proportion of 80% to 95%) and other hydrocarbons in gaseous state (ethane, propane and butane), hydrocarbons in liquid form (pentane, hexane and ethane) and finally, non-hydrocarbons, such as hydrogen, carbon dioxide and hydrogen sulfide gas. The natural gas is obtained from underground deposits of gas and petroleum (associated gas) or gas deposits (free gas). The withdrawal of natural gas from the reservoir is done through tubes to the surface, and in some cases injecting water or other appropriate liquid when there is not sufficient force for the flowing of the gas alone.

Gas supply in Brazil comes from national reserves and imports, mainly from Bolivia, through the Bolivia-Brazil gas duct (GASBOL). According to the *Agencia Nacional do Petroleo, Gás Natural e Biocombustível (ANP)*, the average of national production is 34 million m^3 / day (51.5%) and average of imports is 32 million m^3 / day (48, 5%). For Sant'Ana, Jannuzzi and Bajay (2008) one of the problems for the establishment of competition in the Brazilian chain of natural gas is that there is still not an effective competition in the production, meaning that the gas can only be purchased directly or indirectly of Petrobras. Another problem is that the transport structure is still insufficient and requires large investments in long-term to mature.

Transportation: Involves the sequence of operations for the displacement of natural gas processed (dry natural gas) from the point of production to the point of consumption. It is usually split the activity of gas transport in high and low pressure, creating a physical boundary called "city gate", i.e. in this point the gas pressure is reduced to adjust with the operation pressure of gas duct from distribution system of the local companies. The transport activity of natural gas is one of the links in the supply chain that has, by its nature, very important issues in the economy of natural gas, affecting the viability of its market. The traditional technological alternatives involve gas duct and transportation of liquefied natural gas, but in recent years has emerged in Brazil an alternative method in order to the country distributors promote energy integration, which is called "virtual gas duct" and it is responsible for bringing natural gas to the cities which are not served by the transport network.

Distribution and Storage: The city gate is the point from which is distributed the gas to final consumers. First the gas pressure must be reduced to more appropriated levels and so it is distributed through meshes of gas duct. This responsibility falls to local gas distribution companies (CDL's). The storage can be interconnected to a distribution and / or transport networks. There is also the segment of storage of natural gas, used to regularize the flow of final delivery of gas. This activity occurs preferentially in areas close to consume centers, and it is used to relieve the demand at peak times, reducing the delivery fluctuations and balance the transport system. In the State of São Paulo the rights to distribute the natural gas belong to three companies: Comgas (89%), Gas Brasileiro (3%) and Gas Natural Sao Paulo Sul (8%).

Consumer: The percentage of consumption of natural gas of the currently market segments have the following pattern: households-4%, industry-76%, vehicle-9%, co-generation-5%, generation-4% and other-2%. By the Comgas (2007), the prospects for consumption of natural gas in Brazil are positive for the coming years due to the fact that the natural gas is an environmentally clean fuel and moreover there is an expansion of the network promoted by the distributor companies. Finally, the discovery of new natural gas reserves in the country tends to increase its participation in the national energy matrix.

Studies completed by the Sectorial Chamber of the Sugar and Alcohol of the Ministry of Agriculture show that the fuel considered less offensive to the environment and also cheaper than gasoline, ethanol and electricity should reach the consumer in the coming years. The study shows that the ability to attract the customer will be more important in the next decade than invest in the growth of consumption.

Following the new trends of growth in the natural gas market and considering the end of the monopoly of distribution and marketing of natural gas in the State of São Paulo foreseen to 2011, with the end of the concession contract of Comgas, it is initiated a supply competition of natural gas to the industrial sector. Thus, the structure of the supply chain could be augmented with a new link, generating an open market in the distribution of natural gas, as shown in Fig. 8. This new actor in the chain will have free transit between producers and consumers, i.e. among

generators, distributors, independent producers and free consumers. This freedom of trade can boost the transactions and exert pressure for lower prices.

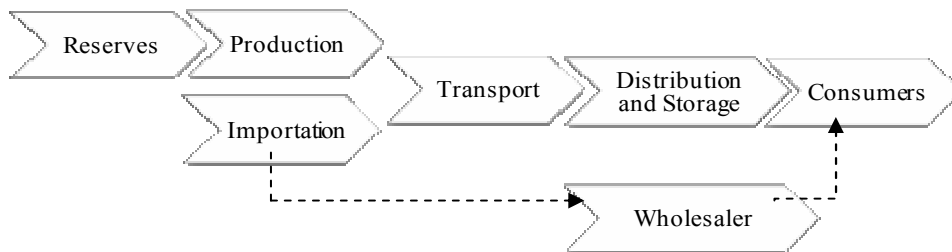


Figure 8. Concession Contract and end of the monopoly period

As natural gas is considered a commodity, the strategic production is based in production “make to stock” supported by estimates of demand. But to analyze the current and future context of the chain is necessary to develop a vision of differentiation which allows addressing the changes in its structure. This new vision must consider that even showing a promising future, the consolidation of natural gas as new energy source becomes difficult, because competes with products which already entered in the market. The solution is the improvement of its products from the criteria identified by the needs of the consumer, in order to be reached its final integration and sustentation in the market. Due to the global era, where companies have high technology and fierce competition it is essential that a company produces innovations and not just products and services. To be innovative does not mean just launch a new and different product with high developed technology, but means the search for improvement of their existing products, discovering new materials, new manufacturing methods and new forms of distribution.

Based on the theory presented, the supply chain of natural gas can be evaluated as a traditional supply chain. Considering future changes in the structure of the chain it is clear that it should be initiated a transition process, searching for integration, which may be a factor of differentiation in the future scenario, where there will be two competing chains in the natural gas industry.

In order to adapt to new trends in the market which is seeking high quality and rapid delivery at low cost (to the improvement of customer satisfaction, increasing the competitiveness of the chain), it is necessary to joint effort between supply chain members of natural gas to redefine strategies drivers to the new scenario. The solution is to increase the level of cooperation and coordination between the companies that make up the supply chain through efficient management, supported by information technology and to change the traditional methods of manufacturing for flexible and agile manufacturing. The Collaborative Supply Chain is the most effective way to solve this problem.

7. CONCLUSIONS

The existing literature allows us to understand the evolution of supply chain and the benefits achieved in the different stages of the process, from the traditional supply chain, through integrated supply chain to the collaborative supply chain, the last being driven by new Trends of the global economy, which leads chains to search for new organizational models to become more competitive.

The development of methodologies, that guide capable supply chains to develop collaboration based on the level of collaboration and cooperation between supply chain members, facilitates the deployment of collaborative supply chain.

The scope of this article is to show how to implement the process of collaborative supply chain, benefits and barriers to their development; to suggest a methodology that allows the chain to determine the suppliers which have a high capacity to add value to its product and make the existing relationship with customers of the supply chain a high collaborative relationship that benefits both sides.

In the chosen case study which evaluated the existence of collaboration within the nature gas supply chain, was initially examined the general context in which the chain operates, noting the existence of a supply chain traditionally monopolized with prospect of changes, due to the expected break in the monopoly what will lead to a change in its structure.

Under the future scenario is unavoidable the evolution of the natural gas supply chain. The adoption of a collaborative supply chain is an opportunity to face new competition, since there is a growing Trent in the consumer requirements in purchasing products with features presented by natural gas.

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