THE COLLABORATION IN THE SUPPLY CHAIN AND LOGISTICS PERFORMANCE IN THE STEEL INDUSTRY IN BRAZIL

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1. ABSTRACT

This paper focuses on the integration of supply chain and logistics performance in the context of the steel industry, highlighting the producing states in Brazil, their integration with other clusters in the state of São Paulo, its divisions in an upstream environment, and Brazil's position among the leading producers in the world, as well as its flow of production. We will demonstrate in this article the intensive use of skilled labor and the shipment of steel products within the context provided. The maintenance and growth of these activities in the region of Santos have made the sectors of trade and services more efficient, contributing to the quality of the regional economy; however, it is important to point out that in the second decade of the millennium, competition sets new paradigms, and competitive advantage is no longer established over a product, but rather by the chain that has reduced logistics costs, which compels supply chains to adapt to an increasingly integrated and responsive scenario. As it is known, a plant uses logistics service providers to guarantee the supply of their raw materials. Suppliers, customers and third parties make up the first layer supply chains. According to Ballou (2006b), the responsive chains are highly integrated. This integration occurs through relationships, which are the object of this study. Our main goal is to analyze the relationships among actors that promote positive changes in the performance of logistics chains. For Bowersox (2006), the three cycles (supply, production and distribution) are intertwined and the logistics management is responsible for coordinating and integrating all units with the purpose of adding value to the logistics system. To this end, we applied a research methodology divided into three stages: the first of which consisted of a bibliographic exploration; the second was the use of a survey tool for data collection that allowed us to confirm the hypotheses of the study; and the final third stage confronted the previous steps for the presentation and discussion of the results.

Keywords: 1. Supply chain. 2. Collaboration. 3. Logistics performance. 4. Steel.

2. INTRODUCTION

The steel production capacity in Brazil was around 42.1 million tons/year in 2010. However, with the beginning of the CSA - Atlantic Steel Company operations and other announced projects, this capacity will reach 77 million tons/year by 2016. China produced 567.8 million tons in 2009, about half of world production (1.2 billion tons/ year) and their annual increase in production has surpassed Brazil's entire annual production. Brazilian exports totaled 8.6 million tons/year in 2009 and 8.4 million tons/year in 2010 (AÇOBRASIL, 2011b), which is worrisome because there has been an increase in imports and that issue has been important to keep equipments operating at maximum capacity, even in the face of domestic market fluctuations.

The exports of flat rolled steel are transported by sea almost entirely, making use of important logistics functions, such as land transport by rail and road, and cargo storage for the formation of export consignments. Shipping is done in bulk carriers, which usually carry consignments of over 5,000 tons each. In 2009, about 1.6 million tons were exported by Usiminas, whose second plant (Usina II) located in Cubatão, São Paulo had a majority role, via the Terminal Marítimo Privativo de Cubatão (TMPC).

The production of rolled steel utilizes intensive labor, as well as the shipment of steel products in ships (cargo stowage), which are specialized activities that affect the regional economy. The maintenance and growth of these activities in the region of Santos stimulates the sectors of trade and services. Thus, new challenges are necessary to find solutions to meet the supply targets (lead times) of the steel industry.

In search of solutions, we took into account studies conducted in the steel industry, among which the work of Moraes and Cardoso (2006) stands out. The authors identified the dynamics of customer relationship in the supply chain of the Steel Company de Tubarão-CST/ARCELOR, Vitória (Espírito Santo), and used the model of Lambert, Cooper and Pagh for visualization of the members of the supply chain.

However, the theme of coordination and collaboration to achieve superior performance in the supply chain of the steel industry was not found. On the other hand, one may observe that the organizational practice of companies in this sector was characterized by "silo"- like internal structures based on accountability, commitment and rewards, as well as the existence of asymmetries among supply chain actors. This investigation required further research to potentially recommend advancements towards value addition and increase in competitiveness.

3. Methodological path

A qualitative research, with an exploratory approach, founded the basis of a process initiated by a survey of specialized literature, technical books on management and supply chain operation, in addition to a scientific methodology, which enabled the establishment of an instrument for this study in a focal firm.

The steel supply chain was chosen because it contains certain characteristics that are favorable to conducting research via electronic questionnaire; that is, it has supplier evaluation programs, a defined organizational structure and available resources for

assessing the supply chain logistics performance. A conceptual exploration of the most important authors on supply chain management was essential, especially those who emphasize the logistics integration as a success factor in performance, such as Christopher (2008), Bowersox (2007), Ballou (2006c), Novaes (2007), Chopra and Meindl (2004), Ladeira and Oliveira (2007), Bertaglia (2009), as well as works by Lourenzani and Silva (2003), Santos (2004), Vieira (2006), Moraes Cardoso (2006) Hilsdorf et al. (2009), Oliveira (2008), Vivaldine et al. (2008), and Conceição Quintão (2008).

A research tool was added at this point so that a single case analysis of a complex large scale steel supply chain would be possible. The chosen method meets the main inquiries of this research, whose chief objective is to understand how events occur, i.e., how supply chains are being managed in the steel industry.

Although the unit of analysis preliminarily defined is the supply chain, some of its processes were prioritized for analysis and verification of the level of integration. Because the chain comprises multiple cycles, it would be impossible for it to be thoroughly analyzed within the duration and scope of this research. About the sampling procedure, the chosen subjects that were initially intended for this research fell short in number (30 respondents) in relation to the estimated universe of 55 technicians who work in the steel sector. Given the initial difficulty, we sought non-parametric methods for the analyzes.

4. Field Research: flows and results

The questionnaire tool, with closed questions, was built in the Likert scale and applied primarily in the target organization and suppliers for verification and further confirmation through cross-checks. The choice of respondents fell upon all executive positions in the supply chain, whose jobs involved superintendence, management and logistics analysis functions, which make them keep close contact with problems and with operational control of the supply chain.

Supplier respondents in managing positions were privileged in this research, considering the low number of executives linked to key processes in the supply industry. We executed the data collection via the Internet, using the survey tool Google Docs (forms).

To elucidate concepts or clarify any topic that stood out in the analysis, we conducted an unstructured interview with senior executives of supply chains. These interviews were conducted to maintain and adjust the focus on the research hypotheses. The quantitative evaluation of the data was performed using descriptive statistics for relations and comparisons in accordance with the following strategy for data processing: estimation of parameters such as median, mode and frequency for non-parametric variables, and standard deviation and regression for parametric variables. It was not possible to use multivariate statistical analysis, due to the small sample size. An exploratory factor analysis was attempted, but did not obtained the required significance ($p < 0.05$). To verify the theory of transaction costs and the theory of logistics performance, linear regression was used to seek correlations between collaboration and logistics performance, as well as between collaboration and transaction costs.

Using the theory of transaction costs we sought collaborative relationships through the dimensions: cost of hiring, specificity of investments, administrative costs of hiring, staff training costs, delays in negotiating and costs with logistics contingency resolution(Figure 1).

Construct	Dimension	Component	Indicators	Basic references
Collaboration	Strategic integration	Objectives and Goals	Involvement of senior management; sharing of strategic data; awareness of partner's difficulties; history of the relationship; contractual horizon.	Ballou, 2006; Simatupang e Sridharan, 2005 Vieira, 2006 Vivaldine et al., 2008 Hilsdorf, Rotondaro, Pires, 2009
Collaboration	Tactical integration	Management Level (Joint Activities)	Person dedicated to the project; Information System for data exchange; transparent communication; degree of dependence; sharing logistics costs.	Bowersox, 2007; Christopher, 2009; Vieira, 2006; Vivaldine et al., 2008 Hilsdorf, Rotondaro, Pires, 2009
Collaboration	Interpersonal integration	Frequency of Interactions	Trust in partner; degree of reciprocity; participation of teams together; number of meetings in the period; technical visits in the period of time.	Ballou, 2006; Simatupang e Sridharan, 2005 Vieira, 2006 Vivaldine et al., 2008 Hilsdorf, Rotondaro, Pires, 2009
Performance	Efficiency/ Effectiveness	Order Fulfillment	On-time deliveries; complete deliveries; error-free delivery; returned orders; seeing to urgent requests; fulfilling orders in a period of high demand.	GSCF/SCOR, 2010; Simatupang e Sridharan, 2005 Vieira, 2006 Hilsdorf, Rotondaro, Pires, 2009; Estampe et al., 2010

Transaction Costs Theory (TCT)	Hiring costs	Contract negotiation	Specific training; IT investments; trading time; resolution of contingencies.	Coase, 1937; Williamson, 1985; Pessali, 1998;

Figure 1 Research Instrument. Source: VIEIRA (2006), adapted by the author.

The above figure reflects the instrumental dynamics of the research, which consolidates the objectives with the main theories used: logistics collaboration, logistics performance and transaction cost theory. According to Vieira (2006), collaboration was crafted by its dimensions: strategic, tactical and interpersonal. For each dimension, we propose a component and key indicators for verification in the research. Likewise, the theory of logistics performance has been verified by the dimensions of efficiency and effectiveness in the process of order fulfillment and their usual indicators. The TCT was evaluated in the negotiation of contracts, investments in assets and in the frequency of contacts among partners.

5. The study of concepts - theoretical elements in the construction of the object of study

The concept of chains of companies is also present in logistics, which deals with the planning, implementation and control of activities relating to the storage, transport and distribution of products and services, from source to destination, in response to the desires of consumers, considering the internal and external activities of this organization (CSCMP, 2010). Since Antiquity, logistics have been present in human achievements, constantly giving support to obtain the results of their undertakings (NOVAES, 2007). The performance was mostly reactive, only observed when some merchandise was not found in the right place at the right time and in the amount needed.

Nowadays, logistics adds value to place, time, quality, and information to goods and services. However, it appears that those who produce goods are not always the same as the ones who transport them; and on top of it, there may even be a third organization to distribute them, making supply chains. Bowersox et al. (2007) found that companies that are part of supply chains with integrated performance could add value to the objectives of the chain. From the point of view of chronological evolution, Novaes (2007) divides these developments into four stages:

1st phase: prevalence of targeted activity even before the 1970s, when inventory control was a primary concern that should be rationalized. Costs of ownership, of making estimates and of transportation are considered.

2nd phase: influenced by the oil crisis and by an industry with greater flexibility in its production processes (variety of products); early computerization of processes while enterprises still focused on production over other functions; optimization of inventory along the chain; use of tools such as MRP[1] and MRP II[2]; sequencing of production whose

[1] *Material Requirement Planning* (a system for planning the material requirements of a plant).

information flow in the chain monthly with little intensity, which was then called “tight integration”. The plan demanded multimodality, since there were increases in inventories and difficulties in distribution, caused by increased production and traffic jams. There was no possibility of intervention in processes dynamically and in real time.

3rd phase: from the end of the 1980s, the use of EDI (Electronic Data Interchange) provided facilities for enterprise integration in pairs, being the barcode the means used to achieve “flexible integration”. However, stocks were still updated at the end of a given period. Organizations sought internal integration and improvement in the relations with their suppliers and customers. Customer satisfaction was a goal, as well as continuous improvement in processes, and "zero inventory".

4th phase: absolute focus on customer satisfaction, with participation of technology to facilitate the flow of logistics, financial and product information. Logistics now adds value to increase competitiveness and win new customers. Global competition justifies the postponement of production to meet customers’ requests in shorter periods of time. Strategic integration takes place and companies become more agile and are called smokeless industries, as customer orders are immediately passed on to suppliers that make deliveries by air. There is more concern about the environment and flows are in reverse relation to products, maximizing customer satisfaction. It is necessary to seek partnerships, expanding outsourced activities, which become increasingly important in the production cycle, as well as breaking down operational boundaries. There is strategic performance to add value and reduce costs to make more business when suppliers already participate in the client’s production process (Novaes, 2007).

The activity of planning logistics operations in any business is full of complexity, be it at any level in the supply chain. Chopra and Meindl (2004) state that the supply chain encompasses all stages directly or indirectly involved in the service provided to a customer, aiming to maximize the overall generated value.

The supply chain has processes that can be segmented into a series of cycles, each of them performed in interface with two successive stages of the chain. The processes in a supply chain are divided into two categories: the ones that are triggered by customer requests (pull), and the ones that occur in anticipation of customer orders (push). For Ballou (2006a), planning can be divided into four basic lines: levels of customer service, facility location in the logistics network, decisions on inventory and transportation decisions. Ladeira and Oliveira (2007) say that demand will require more responsiveness from the supply chain, with a likely increase in costs. Nevertheless, if management decisions that enable more responsiveness are understanding and consistent, the chain can become more efficient, reducing their own costs while serving customers.

Also discussing successive results in the interface of the production chain, Simatupang and Sridharan (20 05) argue that the basic proposition of collaboration is that, in effect, chain members be able to meet customer demand at a lower cost. Christopher (2009) emphasizes that the responsive supply chains are, by definition, highly integrated, both internally and externally, with suppliers upstream, and with customers downstream.

[2] *Manufacturing Resource Planning II* (the planning of manufacturing resources, corresponding to the evolution of MRP, with added modules of master production schedule, purchase control, human resource management, sales and operations planning, among others (PADILHA; MARINS, 2005).

According to Fisher (1997), if the life cycle of a product and its intrinsic characteristics are taken into account, one could divide it into: innovative products and functional products. The latter have long life cycles, stable demands and low profit margins, whereas the former have unstable demands, less competitive pressure, higher margins, to which availability must be ensured. Similarly, for easier understanding, we can define logistics cycles in supply chains as the following:

a) cycle supply: the logistics supply cycle is called "upstream". This flow consists of placing orders for the supplier, transport of materials, reception, conference and movement. Some features can be highlighted, such as: volume and weight of the load greater than in distribution, means of transportation of large capacity due to the weight of the load and the added value of products. Therefore, the supply activities always involve the acquisition and the receiving of larger volumes of products and also larger loads, which require the use of private modes such as containerized shipping in large capacity trucks, ships and trains.

b) production support cycle: generally known as production logistics. It seeks to ensure a smooth flow and low-cost of materials and in-process inventories to meet the goals of PPSC (Production Planning, Scheduling and Control). PPSC activities are developed by a specific department in order to balance the demands with the productive resources of the organization to meet the strategic sales plan. Coordination and implementation of resources take place in production in order to ensure the fulfilment of the goals set at strategic, tactical and operational levels. The process is guided by the make-to-order production policy (production on request), also known as a form of "pulling" production, thereby reducing inventories, specially the inventory of finished products. In this case, the industry produces observing the actual demand instead of what is predicted. Inventories are virtually eliminated; however, customers must wait for delivery, which can affect productivity if this is not common practice in the market.

The PPSC department formulates production plans for the period, as well as detailed descriptions, fulfilling the master production program, through instruments such as MRP and MRP II, which include the functions of scheduling and controlling of production and shopping activities. Thus, as it goes from the aggregate level (production plan) to the least aggregate level (control activity), general directions give rise to more detailed/specific planning; the time period goes from years to days or hours; there is growth in the level of detailing about which products and how much will be produced; the frequency of revision of the plan changes (the planning cycle becomes shorter). The cycle of production, however, is restricted to the levels of efficiency of the internal processes of the organization.

c) distribution cycle: for ocurring after the target company it is called "downstream". This flow generally consists of the following activities: order processing, separation of products in the warehouse, loading vehicles, documentation for shipping, transport and delivery to the customer (BOWERSOX et al., 2007). This physical flow of goods has a strong involvement with sales and marketing, specially considering its variables: selling price, resupply time and availability. Note also the indispensable participation of finance,

production and transportation in this cycle, which may lead to conflict. It is observed that the actors are not always aware of products profit margin as well as the mix that would best translate the goals of efficiency and effectiveness of the logistics cycle, which, from the client's point of view, would be the reduction of the period of delivery and damages. For Bowersox et al. (2007), the three logistics cycles[3] intertwine and it is the responsibility of logistics management to **coordinate** and **integrate**[4] all units (and processes) with the aim of adding value to the logistics system.

The supply chain management is the collaboration among companies to boost strategic positioning and improve operational efficiency. Chain operations require managerial processes that cross functional areas of each company and connect to customers and partners across organizational boundaries (BOWERSOX et al., 2007). It is noteworthy that at the end of the last century, the movement to add strategic planning, marketing and finance to a broader concept, led to the notion of supply chain management (SCM) in order to find solutions to increase competitiveness. Although debatable, many claim that SCM encompasses logistics as it was already known, others claim that the bases of the concepts of SCM were already established in the 1960s. In agreement with CSCMP[5], the current concept of SCM comprehends purchasing and production, besides management of material flows.

One can also observe that emphasis is placed on coordination and collaboration, and also on relationship building among members of the chain. Therefore, SCM can be seen as the coordination of product flows among different organizations, which differentiates this concept from the logistics one, which deals with the relationship and flows within the firm. In practical terms, SCM is about processes that can go beyond a single corporation and that are sets of activities with goals to be achieved (BALLOU, 2006c).

In 1988, Lambert established processes to the concept of SCM, which are still valid today: customer relationship management, customer service management, order fulfilment, demand management, production flow management, supplier relationship management, development of products and commercialization, returns management (LAMBERT et al., 1988 apud BALLOU, 2006c). As it is defined, the SCM is a competitive weapon for those who wish to design and operate a chain to increase the revenues of a firm in order to maximize contribution to profit.

Christopher (2009) emphasizes that the responsive supply chains are, by definition, highly integrated, both internally and externally, with upstream suppliers and downstream customers.

[3] *Supply, production and distribution*
[4] *Authors' highlight*
[5] *Council of Supply Chain Management Professionals*; available at: http://cscmp.org/digital/glossary/document.pdf.

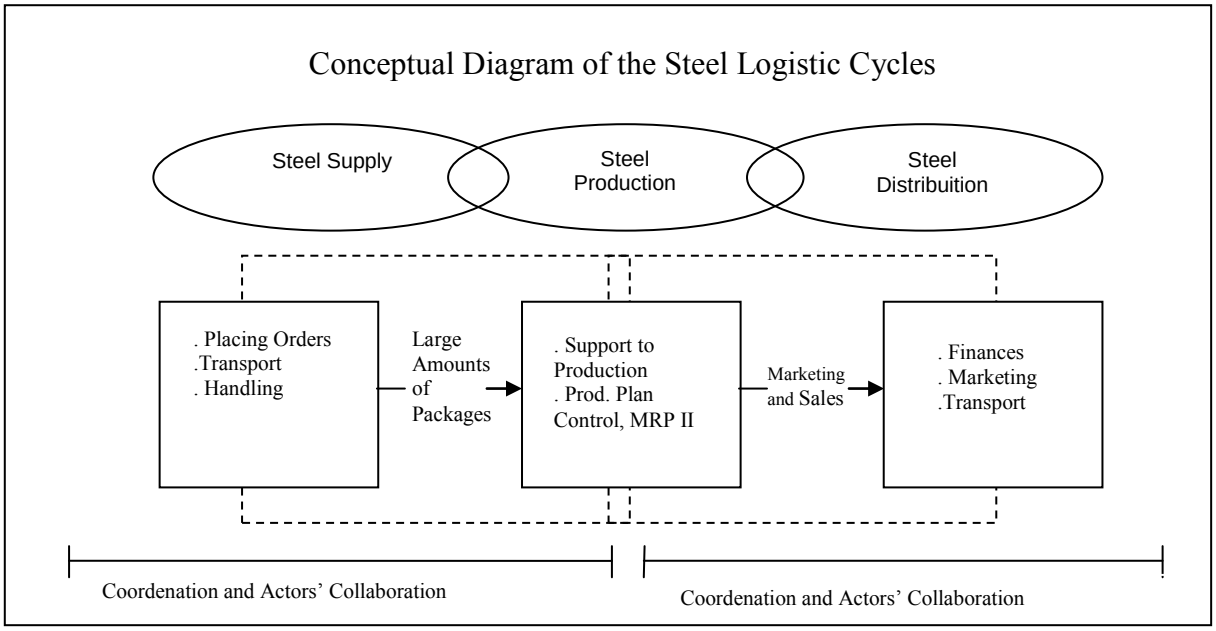

Figure 1 - Logistic cycles and element identification

Source: Bowersox adapted et al. (2007).

In the above figure, the steel logistics cycles are positioned in front of some processes and functions relevant to them, for clarity. Indeed, collaboration and coordination are the keys to achieve the benefits of supply chain management (BALLOU, 2006a). However, these benefits can only be explained by measures of logistics performance, used to compare the performance achieved by partners with the plans they create and identify opportunities for process improvement.

6. Measure of Logistics Performance in the Steel Industry

According to Mentzer and Konrad (1991), a performance measure is given by the efficiency (against the current standard) and effectiveness (with criteria of cost and service level for the calculation of the measure). However, evaluating the performance of a supply chain is a complex task, partly because it is a process involving multiple actors in cross-cooperation to achieve strategic logistic objectives. Such assessments are important particularly in situations where the supply chain is considered a key factor for the success of the company. The elements of logistics performance are surveyed: order cycle time, inventory days, frequency and delivery term, delivery at date, complete and error-free deliveries, product availability, compliance with delivery schedule; frequent deliveries, number of requests returned; stock coverage, fulfilment of urgent orders, and in times of high demand (VIEIRA, 2006).

The Supply Chain Council at 2010 has proposed the model SCOR 10 (Supply Chain Operations Reference 10.0), to describe and define the performance attributes of a supply chain, which can be summarized as follows:

a. reliability, whose basic indicator is the perfect fulfilment of the request;

b. responsiveness, or answer capability, which is most commonly used indicator is the fulfilment cycle time of the request;

c. agility or adaptability / flexibility to meet the special orders;

d. logistics costs, which includes not only the cost of goods sold, but also the total cost of supply chain management;

e. investment management, represented by days in stock along the chain, capacity utilization of resources, time of return to capital invested in raw material and return on assets (SCC, 2011).

To evaluate the performance of a supply chain becomes important to know in detail the chain, its processes, products, information's and flows related. The first question to be asked is about the maturity level of the players in a supply chain. By presenting models for performance evaluation is important to specify whether their basic construction includes a tool for assessing the maturity of a company in this chain.

The Pache and Spalanzani (2007, apud Stamp et al., 2010) approach allows evaluation of the company through the use of a matrix involving a grid of five maturity levels focused on inter-organizational relationships, and aspects of society. According to Estampe et al. (2010), the first model for evaluating supply chain is the CMMI (Capability Maturity Model Integration), or integration model of maturity and capability, which initially considers the structure of the company as the "silo type", ie with individual functions, leading to a poorer performance compared to the model whose vision is open and interdepartmental. This model had five levels, to include: initial, managed, defined, quantitatively managed and optimized, and each level is well characterized to facilitate the decision.

The Model SCOR (Supply Chain Operations Reference) has the capacity to handle the full scope of a supply chain, as explained by Estampe et al. (2010), with level 1: functional integration; level 2: internal integration; level 3 : external integration and level 4: intercompany collaboration.

One up-to-date option was proposed by Pache and Spalanzani (2007, apud Estampe et al., 2010), with five levels of evolution in the relationship, including relevant social aspects:

Level 1: intraorganizational - manages performance combining different functions (design, marketing, production, etc.).

Level 2: interorganizational - integration of all actors operating with the organization (suppliers, service providers, direct customers, etc.).

Level 3: interorganizational magnified - all actors in a chain involved in the search for better performance.

Level 4: multichain - integration into a complex network of relations, where each member company can be at the center of other chains.

Level 5: maturity of the corporation - integration into a global network that incorporates sustainability dimensions associated with performance (environment, society), according to Estampe et al. (2010).

Performance measures are used to approximate chain partners around a dialogue, promoting contacts between functional areas of the business, in daily communications (operational) and also in project development and knowledge of the difficulties and strategies among partners.

Greater involvement results in information sharing and joint actions, completing the cycle of logistics collaboration (VIEIRA, 2006).

4 – Logistics Collaboration

It is possible to observe behaviours and environments where companies compete solely on profits, against each other in an impersonal market (VASCONCELOS; NASCIMENTO, 2005). Ballou (2006c) found that the organization of the last century valued area of responsibility, authority and reward, which prevented the trade off between interfunctional activities, leading to sub-optimal performance of the company as a whole. In that environment, "if some event occurred outside of schedule, each company of that supply channel sought his own goal. There was fierce competition "(BOWERSOX; CLOSS; COOPER, 2007, p.5).

However, with the evolution of technology for transmitting information the practice of collaboration began to appear, with the benefits expected by customers increasingly demanding.

In a supply chain, the company further downstream is the first to feel a severe fluctuation in demand for products / services offered. This oscillation propagates upstream inefficiently in the network, with delayed response and losses in later periods. This phenomenon is known as the "bullwhip effect" in the literature (BALLOU, 2006c). It is believed that collaborative chain would have faster response, with potential to reduce the bullwhip effect in demand management.

In this study, "logistical cooperation" occurs when two or more companies decide to work together to meet the demands of its customers through joint actions, based on interdependence, trust, flexibility and reciprocity, sharing information (VIEIRA, 2006). It is used in this part, the partnerships theory as proposed by Anderson and Narus (1991, apud VIEIRA, 2006).

The collaborative partnerships have been adopted very slowly due to lack of confidence. However, the potential benefits may far exceed those of direct management activity (BALLOU, 2006c). "The collaboration between channel members has the potential to improve the performance of the supply chain by reducing the uncertainty due to demand and delivery terms" (BALLOU, 2006c, p.564). Supply chains generate perceived value to the customer, with the economy of scale, high quality for low price (economic value), with variety of products arranged in the right place at the right time for effectiveness (market value); exclusive, customized with added value, and positioning (relevance value), as noted by Bowersox, Closs and Cooper (2007).

The chain adds value by reducing costs. The elements most often cited when studying logistics collaboration are: flexibility, interdependence, trust, reciprocity, commitment and transparency considered over time. Vieira (2006) justifies a survey conducted by the Brazilian supermarket retail sector that logistics collaboration is directly related to the of strategic, tactical and interpersonal dimensions, the latter being predominant over others regarding logistics performance (VIEIRA, 2006).

In the strategic dimension, there is a discussion by the leaders of the goals and objectives of greater term, meetings for monitoring goals and definition of responsibilities and resource allocation, as well as the alignment of goals. Part of this dimension: knowledge of partners, history of relationships, inventory information.

On the tactical scale, is the management of specific projects, which account for the composition of teams, defining the tasks and suggestions for changes in the organization to meet the goals, connecting efficiently the firms. Part of this dimension: information sharing, costs and gains, and joint actions.

The interpersonal dimension deals with decision makers considering their emotions and personalities, whereas contacts between companies are interpersonal contacts, creating a foundation of lasting relationships in order to create value in the future (Figure 3). Anyway, this dimension deals with the behaviour of agents. Conflicts should be treated in its early stages, before they take shape. This dimension has important factors: trust, flexibility, interdependence and reciprocity (VIEIRA, 2006).

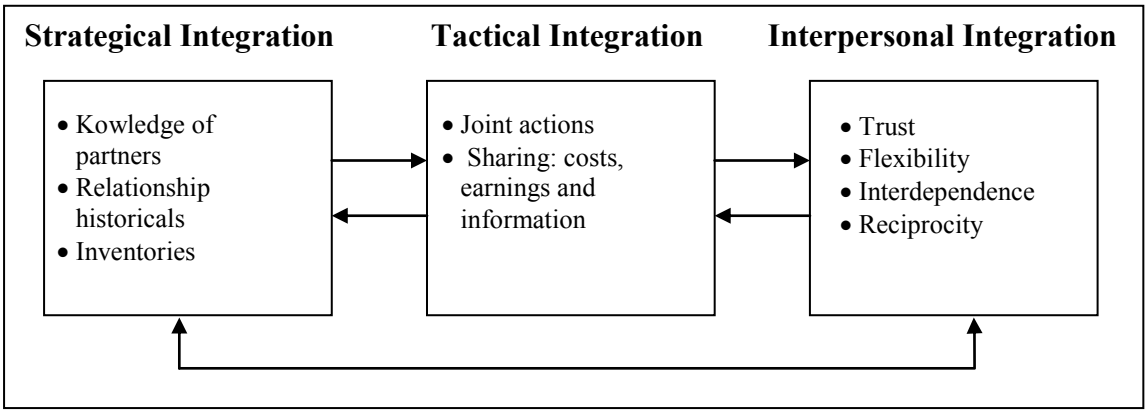

Figure 2 - Model of collaboration in supply chains and their elements

Source: adapted from VIEIRA (2006).

Apparently, the collaboration between firms is a view that is present in many companies, however Vivaldine et al. (2008) suggest that true collaboration is a very difficult concept to be accepted, especially the division of internal information with external partners, despite what many companies recognize the need to work collaboratively with their suppliers and customers. In this sense, we use technological tools to enhance the relationship, such as CPFR (Collaborative Planning, Forecasting and Replenishment) which is a system designed to facilitate collaboration between companies, especially regarding sales forecast. Its success will depend on basic issues such as the existence of internal processes to these companies well structured and operated, and still the settlement a solid relationship between the partner companies. (FIGURE 1)

This new paradigm (strategic alliances) presupposes some consolidation of partners, either upstream or downstream in the chain. However, in this new environment, the partners will have greater responsibilities in management. "The alliances allow partners to a combination of variables that cause gain competitive advantage, with new levels of profit and market share" (BERTAGLIA, 2009)

For this success, the organization depends on collaborative processes of planning, implementation, monitoring and formalization (VIVALDINE et al., 2008), that will enable the emergence of a new operating environment.

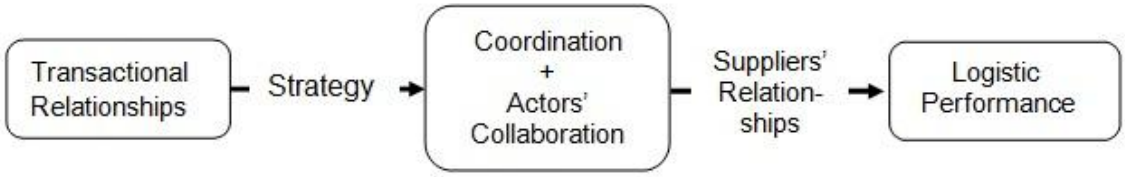

Figure 3 - Structure of the model and the relationships between the elements

The above scheme illustrates what the theory suggests for firms that implemented the supply chain management in the cycle upstream, when starting from a situation where management happens through accountability, authority and rewards (standard “silo”), for a more horizontalized management and comprehensive, process-based, knocking operational boundaries and working the chain.

For this research, interested chains that support the production of steel, among them those dealing with raw materials, ranging from the origin (port, mine or factory) to the destination (port, material yards or plant) . Among the various processes, giving priority to the management of supplier relationships by connecting with such problems, to ensure the fulfillment of the demand of steel production. Therefore, the management of relationships with suppliers provides the framework for the creation and maintenance of relationships, which are categorized according to several dimensions, such as its criticality to the organization, contribution, expertise or even exclusivity"(LAMBERT; STOCK, 2001) .

The supplier relationship happens in the organization through its structure, especially the productive purchasing area, the engineering quality, or the quality department and even the area of logistics, which may be linked to production or manufacturing department (RODRIGUES; SELLITTO, 2009). Firms usually see this process from the perspective of quality, like Juran explains, when he says that the main objective of a closer relationship with suppliers is to create a relationship that ensures that the product meets the needs of suitability for use with a minimum of incoming inspection and corrective action (JURAN, 1992).

However, companies usually use criteria for supplier selection based on the parameters of quality, price and delivery time (ALVAREZ; QUEIROZ, 2003). Bertaglia extends the range of these parameters adding financial health; guarantees; history; ease of information exchange, training investments, reputation, location, expertise in transportation, technology, cycle time, ability to meet expectations, availability of services and products; speed; labor relations; delivery performance, lack of products; faults; complaints and perfect orders (BERTAGLIA, 2009).

7. 4. FINAL REMARKS

The role of collaboration in advancing of the integration of supply chains is still a reserve of wealth to be exploited (BALLOU, 2006a). In this sense, this research sought as their goals, identify and interpret the elements of supply chain integration in the steel sector in Santos Metropolitan Region, related logistics performance.

Implemented an evaluation of quantitative research for the steel industry as the advances in the management of supply chains, however, the data collection was below expectations, despite having achieved a rate of return of 25%. It was used for data analysis parametric techniques, when it was possible before the sample size for analysis of internal consistency and scale reliability (Cronbach's alpha), and data normality test (Kolmogorov-Smirnov). As a result, the variables were evaluated by non-parametric tests of Wilcoxon marked orders by assessing the ability of discrimination variable, obtaining the value “z” of the test with confidence always above 95%, which is essential to eliminate any possibility of the occurrence of results by chance, given the sample size.

The Kolmogorov-Smirnov test confirmed the suspicion that most of the variables did not meet the normal range (67%), with minimum 95% confidence.

For the research of association between variables was used Somers'd directional measures tests, measures symmetrical Kendall T b, and the measure of symmetric Gamma correlation (ranging from -1 to +1), for ordinal variables, and the Spearman correlation coefficient in order to obtain a convergence that could point out, with confidence, the correlation sought.

For analysis of hypotheses, when was mathematically possible, we used additionally linear regression in their simplest form because the sample size.

Therefore, there was confirmation of the theory of collaboration in all analyzes of cases, mainly assessing the maturity level of the supply chain, as follows:

H1: company’s logistics planning reaches focal suppliers associated with key processes for supplies.

H2: there are management lead times, aiming at meeting deadlines, reduce inventory and supply chain integration upstream.

H3: the integration process occurs with the sharing of information on products and markets via computerized systems.

H4: the monitoring of external operations for distribution of finished products is conducted to meet the schedule.

H5: logistical performance indicators for the chain are developed and used, evaluating the efficiency of the cycles of activity.

Besides the confirmation of the hypothesis of this research, we conducted an analysis of data looking for evidence of association between variables of collaboration and logistics performance variables. For Ballou (2006b), responsive chains are highly integrated, namely that the chains have a high logistic performance must be integrated. Since the integration is determined by collaboration between partners, it is expected to observe the association between collaboration variables and logistic performance variables (Figure 5).

Construct	Factors	Collaboration Variables	Performance Variables	Method	Evidence
Collaboration	Strategic	Level Inventory Information Sharing	1. Completed Deliveries	Non-parametric tests (Somers' d, Kendall T b, Gamma and Spearman)	Yes
			2. Completed Deliveries with Delivery frequency (control)		
			3. Completed Deliveries with Joint Activities (control)		
			4. Constant Delivery		
	Interpersonal	Interdependence	Completed Deliveries	Non-parametric tests and Linear Regression	Yes
	Tactic	Delivery Point Information	Availability of products	Non-Parametric tests and Linear Regression	Yes

Figure 5. Analysis of Correlation Between Collaboration and Logistics Performance

According to the figure above, evidence has been demonstrated between the cooperation construct and the construct logistic performance, through non-parametric tests and in some cases linear regression, since this method was used sparingly because the sample size, which has repercussions on the detection power and significance of results.

Also with regard to the theory of transaction costs evidence was found, by the same methods as shown in Figure 6.

Construct	Dimension	Collaboration Variables	Costs of Transaction Variables	Method	Evidence
Transaction Cost Theory	Asset Specificity Degree	Logistics Cost Sharing	Employee Training for New Projects	Non-Parametrics and Linear Regression	Yes

Figura 6. Analysis of Correlation Between Collaboration and Transaction Cost Theory

This research concluded his goals because it could examine the hypotheses, that converged to expected propositions. In addition to the findings above, the analysis also showed positive correlations between the construct collaboration in its dimensions strategic, tactical and interpersonal with logistics performance, but also a positive correlation between collaboration and transaction cost theory, albeit incipient, depending on available sample.

Data analysis showed that the competence of the respondents to treat the issues, as they are dealing with executives and daily perform as manager of these supply chains, some with over 20 years of experience, were fundamental.

Therefore, the evidence, positive or negative, was considered only associations between variables, because not all variables were associated, as expected. One should recognize the low detection power of the regressions performed, and significance, given the size of the sample worked. It is recognized also that the parametric statistical procedures have greater predictive power / detection, for the same sample size (N), although the coefficients of Pearson and Spearman converged on tests conducted in this research.

The results found in this study, it is suggested that other investigations using a larger universe, more respondents, not only logistics analysis applicants, but others in related areas such as procurement, finance and accounting, among others. Such action could extend data variance and subsequent application, improving the methodology suggested in this work.

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