



STUDY OF FRUIT PULP CHAIN FROM THE PERSPECTIVE OF SUPPLY CHAIN MANAGEMENT (SCM)

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ABSTRACT

Globalization and the advent of Information and communication technologies have influenced substantial changes in forms of management. The intense global competitive scenario have generated new forms of competition for the various players. Faced with the unstable and complex environment, organizations need to focus their efforts on shared strategies. Agribusiness presents a set of specificities that lead to greater complexity to manage the activities. Regarding the agro industrial fruit pulp chain, this dynamic becomes even more complex, considering the peculiarities of the sector. Therefore, this paper aims to describe the fruit pulp chain from the perspective of the business processes of Supply Chain Management (SCM).



To do so, eight business processes were considered for the qualitative analysis supported by the bibliographical research on a well-known scientific basis such as Web of Science, Scopus and EBSCO. Considering the study of a current phenomenon and according to the profile of the research agents, it is a multiple case study applied in four fruit pulp processing agro industries. The results describe the business processes and the activities that compose it in the fruit pulp sector, allowing understanding the synchronous and dependent relationship between the processes, as well as the importance of information sharing in the dynamics among all activities.

Keywords: Supply chain management; SCM, fruit pulp; business process.

1. INTRODUCTION

The different economic changes, such as the phenomenon of globalization, have created the need for adaptations in the markets, making them more competitive and increasing their unpredictability and uncertainty (SHUKLA; JHARKHARIA, 2013; FERNANDES; BERTON, 2012). Local businesses have become global, giving new forms of competition faced by the various agents within this complex (COSTA, 2009).

The competition between companies has led companies to take different actions to achieve competitive advantage. Often, these actions prioritize continuous processes of innovation that confer benefits such as better levels of quality and differentiation of products and services (STEVENS; JOHNSON, 2016).

Supply Chain Management (SCM) emerges with the objective of promoting the alignment between the links within the supply chains in which corporate autonomy gives place to the collaborative work. In this way, companies act in a systemic manner, facilitating the bidirectional flow of business and information, causing feasible gains in the network (GAYIALIS et al., 2015).

SCM can be considered as an expanded approach to traditional materials management as it requires a more competitive positioning of its agents. This breakdown of competitive paradigm clarifies that competition occurs between productive chains and not between isolated business units. Thus, organizations cannot be considered closed systems, but open systems and dependent on the other agents that compose this complex network (FERRAGI, 2016; PIRES, 1998).



The importance of research that applies the precepts of SCM in agribusiness is based on social and economic impacts because the sector integrates a representative part in the supply of raw material to the industry, besides being important in the generation of employment, income and food security. In this context, Zylbersztajn (2017) presents the concept of interdependence within agro industrial systems and states that agribusiness has become part of an interdependent network, meeting the definition proposed by Davis and Goldberg (1957), corroborating with the concept proposed by SCM.

Scramin and Batalha (1999) argue that in face of adversities affecting agribusiness, such as decreasing returns aggravated by structural factors, the studies are increasingly focused on solutions to the sector (HOWIESON; LAWLEY; HASTINGS, 2016). Given the complexity associated with its productive arrangements, this study represents an opportunity to identify bottlenecks and to promote improvements.

Through bibliographical review, several articles were identified that used the scope of the SCM, such as Peng et al. (2016), Skrinjar and Trkman (2013), Hwang and Lu (2013), Cao, Gan and Thompson (2013), De Maio et al. (2016) and Ageron, Lavastre and Spalanzani (2013). However, they do not go into the business process completely. In this way, it reinforces the theoretical and practical importance of the present study, since besides presenting the main theoretical delineations of SCM, it contemplates the complete analysis of the eight business processes. Regarding the area of knowledge of the fruit pulp chain, several studies on the physical-chemical composition of the pulp were identified, but few are related to the supply chain management.

In view of such assumptions, as well as the unstable and dynamic nature of the productive arrangements in this productive chain, this paper presents the general objective of describing the fruit pulp chain from the perspective of SCM's business processes.

The paper is structured in the following sections: the first section is composed by the research method; the second section is devoted to the results and theoretical framework about the SCM and the eight business processes according to the definition proposed by Lambert, Cooper and Pagh (1998). Finally, the third section contains the conclusions and propositions for future studies.

2. METHODOLOGY

The methodological contribution of the work was carried out through a bibliographical review, with an exploratory-descriptive approach. Considering the study of a current phenomenon, given the empirical nature of the research and the profile of the research agents, it is a multiple case study (YIN, 2010). In order to conduct it, pre-established steps were adopted, according to the model coined by Miguel (2011): (i) define a theoretical conceptual framework; (ii) case planning; (iii) data collection; (iv) analysis of results; (v) report generation.

The bibliographic review provided an understanding of the current configuration of literature on industrial engineering area, which includes SCM and business processes. The bibliographic review also provided an understanding of the specificities that permeate agribusiness and the fruit industry, allowing for the construction of the results from the SCM perspective. This step was supported by the research of scientific materials in the search bases Web of Science, Scopus and EBSCO.

The planning of the cases included the units' selection, and the first contacts were made in August 2017. Regarding the form for data collection, questionnaires with open questions were used. The questionnaire enables documented measurement and description of the fruit pulp chain from the perspective of business processes. Two theoretical approaches were set out for each of the processes and the questions were constructed from the theoretical approach.

After the planning of the cases and the elaboration of the questionnaire, the field research was carried out with four fruit pulp processing agro industries located in the state of São Paulo, Brazil, as shown in Table 1.

In addition to the application of the questionnaires, it was contemplated the observation with the professional responsible. According to Miguel (2012, p.137), “[...] visits to the shop floor are important in order to verify, *in loco* and/or *in modus operandis*, the studied phenomenon [...]”

Table 1: Characterization of Agroindustries

Agro-industries	A	B	C	D
Organization	Private company	Private company	Association	Cooperative
City	Dracena	Parapuã	Adamantina	Junqueirópolis
Annual production	7 thousand tons	280 tons	50 tons	150 tons
Number of suppliers	500	50	340	100
Qty of flavors	5	15	8	8
Flavors	Pineapple, acerola, guava, mango, passion fruit	Pineapple, pineapple with mint, acerola, acerola with orange, blackberry, cashew, guava, mango, papaya, passion fruit, melon, strawberry, lemon, tamarind, grape	Pineapple, pineapple with mint, acerola, cashew, guava, passion fruit, strawberry, grape	Pineapple, acerola, cashew, guava, passion fruit, mango, strawberry, grape

Source: Prepared by the author from data provided by the research units.

3. RESULTS

3.1. The Fruit Pulp Sector Supply Chain

The results indicate that agro-industries are the weakest link in the chain of the fruit pulp sector and are characterized by the low level of commercial organization. This reality is in line with scientific studies such as, Camarano and Abramovay (2017), Castro (2009), Cavalcanti, Andrade and Rodrigues (2012) and Elias, Muniz and Bezerra (2007). These studies take on the background of the characterization of the Brazilian rural producer, emphasizing the present challenges in the sector.

The supply chain presents interdependence as a fundamental characteristic. The fruit pulp supply chain is no different (CONORADO et al., 2015). In this way, an agent will not be able to achieve satisfactory results without interacting with the other agents. In addition, uncontrollable variables such as perishability should be considered, which generates an increase in operating costs and a change in quality, compromising efficiency from downstream to upstream (GUNDERSON et al., 2014).

According to Lavastre, Gunasekaran and Spalazani (2016) there are other risks linked to the supply chain such as delays, forecasting problems, purchases, receivables, inventory and production capacity. Christopher and Peck (2004) classify five categories of risk: process, control, demand, supply and environment Kleindorfer and Saad (2005) consider risks as operational (problems with equipment and systems) and natural (including climate instabilities and natural disasters).



It is worth mentioning that changes in the profile of the population's food, encouraged by the search for healthier eating habits, has driven the development of fruit crops (KEPLER; FAIR, 2015). This scenario, coupled with the climatic diversity and territorial extension of Brazil, reflects the growth potential of the sector.

Figure 1: represents the fruit pulp supply chain and the agents interacting with it.

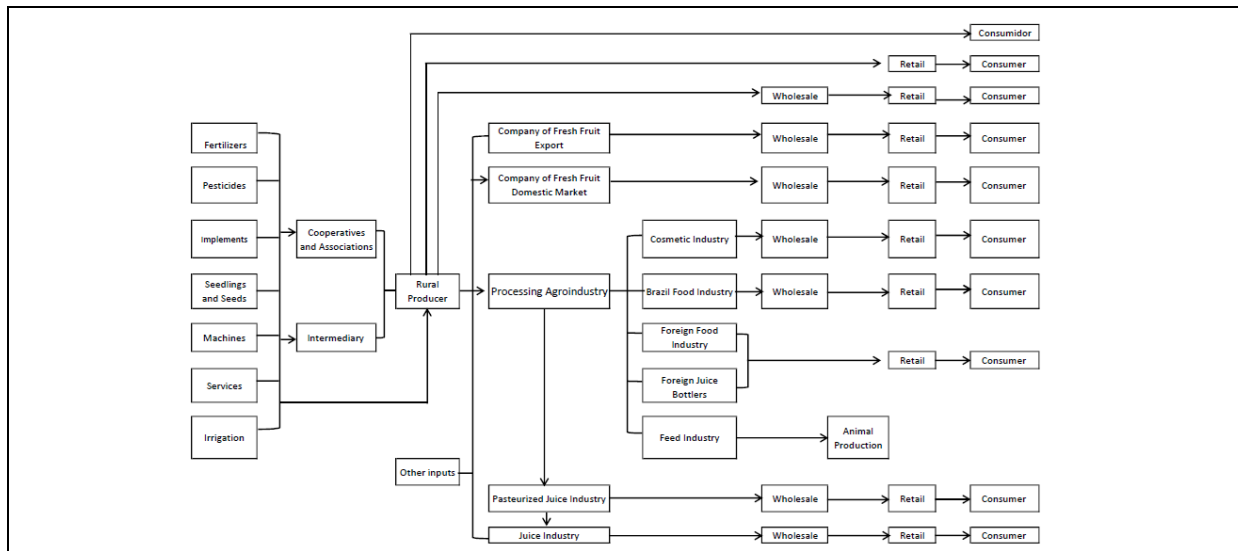


Figure 1: Fruit Pulp Sector Supply Chain
 Source: Prepared by the author based on data collected

The first tier is composed by necessary inputs for growing and dealing with crops. The commercial relations between these companies and the rural producers are direct or through associations, cooperatives or other intermediaries, depending on the size and degree of organization of the agents.

The second tier is composed of agricultural cooperatives and associations that operate, in most cases, in the commercial organization of producers, offering services, trading inputs and other products at a lower market cost. In this tier, there are also the intermediaries that commercialize the inputs, linking farmers to manufacturers of agrochemicals.

The rural producer can relate to both, the industrial sector and the domestic market. Regarding the industry, there is the possibility of commercialization with the processing companies as of pasteurized juices and ready to drink juices. Regarding domestic market, it is possible to sell *in natura* fruits to supermarkets or to final consumer in farmers markets for example. Some rural producers invest in the sale to the foreign market, with the export of the fruit. However, phytosanitary

requirements may pose barriers to small farmers, since few of them have the financial structure to afford adaptations to market and legal requirements.

Agro-industries sell the pulp to pasteurized juice industries or non-pasteurized juice industries. The commercialization of fruit pulp can take place both in the domestic market (wholesale or retail) and in the external market. Food market is the main destination of fruit processed products in Brazil, either for ready to drink juices, pasteurized juices, ice cream or candies. In addition to having intense participation in several segments of the food industry, fruit pulps are also used in the cosmetics sector and for the manufacture of animal feed.

3.2. Customer Relationship Management

Customer relationship allows for identifying the profile of the client and direct measures to make them loyal. Among the tools used to facilitate this communication are websites, e-mails, social networks, call centers, sales points and other strategies that facilitate marketing management, sales, pricing and production planning (LAMBERT, 2016; CHEN; POPOVICH, 2003).

The results indicate that one agro-industry that exports fruit pulp identifies a demand to access a specific market. In order to reach the marketing channel, it adopts a certification (such as Kosher certification) or good practice procedures, such as HACCP (Hazard Analysis & Critical Control Points), to broaden its capillarity of action at international level. In this sense, empirical evidence corroborates the importance of the flow of information in the supply chain, whether for the management of short-term resources or for the expansion of the market.

The results demonstrate that agro-industries create formal partnerships with key clients or with all clients. In addition, it was reported that when faced with eventualities, such as the impossibility of meeting a contractual requirement, agro-industries choose to buy from another supplier, to avoid contractual breach in the relation with clients. These actions affect the issues related to the way agro-industry manage relationship with clients, which includes closing of purchase orders, bargaining for prices and deadlines, establishing agreements, ordering changes and all issues that might improve the commitment between these tiers.

3.3. Customer Service Management

This business process refers to the development of actions to manage customer orders, being supported by the administration of products and services. The responsible team should establish strategies to optimize this relationship, determine communication channels and write a plan of action to measure management alternatives and their impact on company activities (SIMON et al., 2014).

Regarding the post-sale service, fruit pulp agro-industry provides the essential information to its clients, such as the manufacturing lot, expiration date, payment situation, delivery methods, quantity sold, type of transportation used and other relevant logistical information. In addition, the team should inform clients about any potential problems.

Regarding the communication channels used in this process, we identified channels of registered and formal communication (websites, social pages, emails and phones), and not registered and informal communication, such as online communication chats or face-to-face communication, given the physical proximity between them. This business process stood out positively, revealing the inexistence of problems of greater complexity in the process of communication between and agro-industries and clients.

3.4. Demand Management

Demand is influenced by the flow of information along the chain, so if a tier holds strategic information, such as inventory levels, sales patterns and logistic procedures, it will be difficult to reach efficiency in its management. Although demand tend to be stable in the food chains, it is necessary to look at aspects such as infrastructure, transportation conditions and productive capacity (SCRAMIN; BATALHA, 1999; MELO; ALCANTRA, 2016).

Demand management in the fruit pulp chain must align the needs of the clients with the production capacity of the agro-industry. Exchange variations should be monitored if the production is destined for export, as it may directly influence the demand by importers.

Fruit Pulp, besides being destined for consumption as natural juice in domestic market, is also widely used as raw material in the production of candies,

jellies, ice cream and nectars. As the pulp has a longer shelf-life than fresh fruit, there is the advantage of processing during the harvest period and marketing in more favorable periods according to the demand of the consumer market. Therefore, the team in charge of demand management should have contingency plans to synchronize supply and demand, periodically review plans, conduct inspection of production capacity, and interact with other business processes.

3.5. Order Fulfillment

Defined as a set of essential factors to fulfill the requirements, this process is responsible for the interaction between client and company, including the main transactions of the operational and strategic level (CROXTON, 2003). Within this scope of action are the activities of order monitoring, delivery security, monitoring of the structure responsible for production, logistics and marketing. It stands out interdependence with the other business processes, such as communication with customer relationship management (SIMON et al., 2015; CROXTON et.al, 2001).

This business process can directly influence manufacturing flow management, since it is the information derived from this process that will initiate production operations, whether in the purchase of the raw material (fruits), packaging or in the production and delivery planning of the final product.

The personnel responsible for this management should determine the specific steps from the order placement to delivery of the final product as well as verify the customers' credit and, thereby, direct the possible forms of payment. They should also identify the productive capacity to meet higher demands, communicate the management team of customer service when the order is delivered, and share information to those in charge of demand management.

In the fruit pulp sector, the fulfillment of the request can become more complex due to the nature of the requisitions and specificities of agro-industrial chains. Climate instability, for example, may have great influence, with the fulfillment of the request of the agroindustry, thus maintaining a good relationship with suppliers and an essential condition to reduce this risk.

3.6. Manufacturing Flow Management

This process refers to production management strategies, which include capacity plans, needs and constraints. The flow is established to harmonize the

actions of the company according to the demand, prioritizing the needs of the clients. For this, it acts in the development of actions aimed at increasing the flexibilities, pointing out the nonconformities (SIMON et.al, 2015; LAMBERT; ENZ, 2016).

Production in the fruit pulp sector consists of the following steps: (i) Reception and weighing, depending on the period it is necessary to store the fruits in temperatures between 5° C to 12° C; (ii) Selection, washing and rinse. The fruits are separated according to their physical conditions, discarding those which are spoiled or demonstrate non-conformity with quality. The first wash aims at cleaning superficial impurities, whereas in the second wash they are immersed in chlorinated water for about 20 to 30 minutes; (iii) Peeling and Cutting is the stage where fruits are weighed to control productive flow. The cutting may be manual or mechanical, and unused remains should be placed in closed containers to avoid attracting insects; (iv) Pulping consists of separating the pulp from the fibrous material. Crusher, disintegrator or industrial blender carries out the crushing; (v) Packaging and filling can be performed by means of automatic, semi-automatic or manual dispenser; (vi) Freezing and Storage.

The bags used in the packaging are polyethylene plastic, the size varies according to the type of marketing channel (domestic market usually demand smaller portions and drums are usually used for export markets). The aforementioned productive steps, such as peeling, and filling will vary according to the type of fruit processed, since they differ in their physical structure, fibrousness, consistency and bark stiffness. It is up to the responsible team for the productive process to direct the best way, as well as the processing sequence to achieve time saving.

3.7. Supplier Relationship Management

This process promotes essential conditions in the process of creating and maintaining the relationship between company and suppliers (LAMBERT; SCHWIETERMAN, 2012). It has strong singularities with the management of the relationship with the client concerning the activities and the structure set up to develop the strategies of loyalty, communication and selection of these agents (LAMBERT, 2004).

In the agro-industrial fruit pulp chain of, rural producers are responsible for supplying the raw material necessary for the company's production process.

Because these are sensitive products with high perishability, agro-industry must address to some aspects such as the location of suppliers, deadlines and transportation conditions to not jeopardize the quality of the product and generate losses. Rural producers should be located close to the productive units in order to facilitate transportation and reduce transportation waste.

The deadlines for delivery should be established in advance among those involved, as well as the requirements such as quality and maturation of the fruit. In addition to the main suppliers, there are the suppliers of secondary products as spare parts suppliers of the machinery, which are important in this business process although they operate with less periodicity.

3.8. Product Development and Commercialization

This process is responsible for providing structure for the development of new products, being supported by the relationship management processes with customers and suppliers (ROGERS et al., 2002). Marchesini and Alcântara (2014) define it as a set of elements that provide structure for the creation and launch of new products and services. The functions of manufacturing flow management act in the technological and strategic development of the productive capacity and analysis of the possibilities inherent in the production line (LAMBERT; ENZ, 2016).

According to Evangelista and Vieites (2006), the sector features associated with conditions such as seasonality and high perishability drive the technological development that guarantees the commercialization and consumption during an extended period. That allows for the extension of the shelf life and adds quality and value to the product, besides acting in the reduction of wastes in the transport and storage of the *in natura* fruit.

This business process is challenging for the managers of the fruit pulp chain, as it is a natural product. It was observed that Innovation and development have focused on aspects related to the mixing of more than one fruit in a single package, such as orange with acerola and addition of other ingredients such as mint in the pineapple pulp. In this scenario, the commercialization of fruit pulp for detox juices, directed to a specific target market, is glimpsed. This type of drink consists of adding vegetables and other ingredients such as cabbage, ginger, tomato, carrot, flaxseed, among others to the fruits. This process is not necessarily related to the creation of

an innovative product. The adoption of partnerships with suppliers to encourage the production of more exotic or typical fruits from the northeast region as açai and cupuaçu is also considered an ongoing practice in this business process.

The commercialization of fruit pulp is facilitated by possibility to transport long distances, fact that is not simple for the commercialization of *in natura* fruit. In addition, it is possible to export fruit during the off-season. Sale is carried out by the company itself or through intermediary agents, such as commissioned dealers or representatives. The commercialization costs regarding transportation is responsibility of the agro-industry when the company sells directly to its clients, requiring investment or outsourcing of the logistics activity.

3.9. Returns Management

Return management works to reduce idleness, unwanted returns, and achieve healthy competitiveness (LAMBERT, 2004). It is related to the activities of reverse logistics and maintenance and its implementation, besides contributing to the efficient flow of processes, also serves to identify bottlenecks and generate opportunities to soften them (LAMBERT; ENZ, 2016; MARCHESINI; ALCÂNTARA, 2014).

Among other quality service procedures, it is highlighted the inventory control, since the fruits cannot be stored for extended periods. Thus, the fruits should be stored in sanitized plastic containers and identified by date, lot, quantity and time. The stock of the finished product must remain under adequate refrigeration, with cross contamination control that refers to the possibility of contact of the raw material with the finished product, so that there is no contamination of microorganisms present in the fruits.

The cleaning of environments should be carried out daily, emphasizing the control of pests by using door, window and drain sealing, being strictly prohibited the presence of any animal in the agro-industry. Finally, there should be records, and controls performed for each stage of the production process, as well as any interruptions that have occurred.

By products resulting from fruit processing such as peels and seeds can be reused in the manufacture of other products such as animal feed and cosmetics. Ferrari; colussi e Ayub (2004) highlight the high concentration of fatty acids in

passion fruit seeds having nutritional importance for human food and animal feed, besides being present in the manufacture of cosmetics, paints and soaps. The practice of reverse logistics represents the reuse of materials with the correct and sustainable destination, in addition to providing economic value to products previously discarded.

In addition to the aforementioned practices, it is possible to consider the machinery maintenance processes, in which there is a need for replacement of specific parts and equipment. This maintenance can generate returns to suppliers of these materials or service providers for possible repairs, which is a task that is part of the return management process.

4. CONCLUSIONS

Although the eight business processes have been analyzed here individually, it is possible to conclude that they have a strong synchrony relationship. In addition, sharing information among the teams responsible for each business process is critical to the efficiency of its execution. Customer relationship management and customer service management bring together a set of important data that can generate execution and planning orders in the process responsible for managing demand, manufacturing flow management and order fulfillment.

Managing the manufacturing flow, besides contributing to the organization and optimization of the production process, also guides the quality control procedures that must be strictly follow technical procedures and good manufacturing practices. Efficient management of this business process will reduce the potential for failures and bottlenecks in the return management process. In addition, consideration should be given to the use of fruit byproducts, such as seeds and bark, which are resold to other agro-industries for the manufacture of animal feed, cosmetics and soap.

The uncertainties and unpredictability that affect production chains, coupled with the specificities of fruit pulp chain, imply greater complexity in the sector's performance. In addition, there are often failures in performing business processes in different tiers, resulting in a disorganized configuration and information asymmetries, which makes more difficult to manage activities efficiently along the chain. Based on such clarifications, the importance of the practice of business processes in the

supply chain management in the fruit pulp sector to avoid losses and to create competitive advantage is aligned with literature statements

The practice of information sharing is one of the key points for achieving synergy in a supply chain. However, we observed that there are agents who are resistant to the exchange of information as a strategy for synchronizing activities. Such resistance may be based on the uncertainty or distrust on other agents' actions, given the possibility of opportunistic behavior.

The analysis from the perspective of SCM and the business processes in the fruit pulp supply chain represents an academic and practical advance, being therefore an innovative contribution. Considering the investigative nature of science, it is noticeable that in finding answers to old problems, other questions arise from other research problems. In this context, as a way of improving the intrinsic relationships between the different supply chain links, as well as overcoming the challenges arising from other market demands, we see different gaps that represent opportunities for future work.

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