



Analysis of a supply chain in the light of the LCP model: a case of the shrimp sector

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Summary. Managing the factors that influence the operation of a supply chain is a fundamental part of an organization's strategy. As a consequence, the model of Lambert, Cooper, and Pagh stands out by establishing the purpose of supply chain management to manage the relationships between member companies to obtain a competitive advantage. In this context, this article's main objective is to analyze the supply chain of an organization specialized in shrimp farming, using the referred model, by evaluating its structure, business processes, and management components. For the synthesis and analysis of the results, the SWOT Analysis was used to list all the strengths, weaknesses, opportunities, and threats of the organization from the critical analysis of its internal and external environments. Therefore, it was possible to identify the strengths and vulnerabilities of the shrimp farming process in ponds. With the definition of these factors, it is expected to carry out better planning for the management of the chain under study, providing a competitive differential for the studied company.

Keywords: Supply Chain, LCP Model, Shrimp farming.

1 Introduction

Supply chains are organizational structures that integrate activities involving the supply, production, and distribution of goods or services, from the purchase of raw materials and inventory control to transporting the product to the final customer [6]. Consequently, the main objective is to synchronize supply and demand to reduce costs and improve consumer satisfaction [27].

The new market configurations and their requirements have brought to the supply chains a latent need for changes in their operating strategies, given their competitiveness. Thus, creating dynamics in these arrangements requires business maturity, mainly because of the complexity inherent to supply chain processes, such as the frequent changes in distribution configurations, when aggravated by conflicts of interest between supply chain partners, can make the chain vulnerable [3].

For Gomes and Ribeiro [10], some factors can help supply management, such as information technology, integrated management, agile response capacity, financial

management, and digital transformation. The challenge is to readjust traditional arrangements to foster value creation and, at the same time, achieve viable costs throughout the process. However, all activities in the chain must be very well planned and optimized to generate positive results [29].

In addition, Corrêa [6] claims that adequate supply chain management is an emerging need in the most varied segments, as it is crucial for obtaining a competitive advantage.

Concerning shrimp farming techniques for human consumption, shrimp farming is the commercial cultivation of shrimp in ponds. This segment combines several strategic and functional activities to coordinate and collaborate between chain members, such as service and input suppliers, processing and transformation industries, distribution and commercialization, and final consumers [5], [9], [14].

Among the critical aspects of shrimp production, the analysis of the main links that make up the production chain is necessary: (i) identify the hatchery laboratories (first-tier suppliers), in which the post-larvae are produced; (ii) the fattening farms, responsible for the shrimp development cycle; (iii) the processing centers that prepare the product for the market [19], [20].

The success in the production of the shrimp farming sector is associated with handling the stages of the production process. In this regard, Brazil has stood out for attributing innovative resources and strategies [14], [24]. Furthermore, the country has shown a positive response to investments in the sector, as shown in Figure 1.

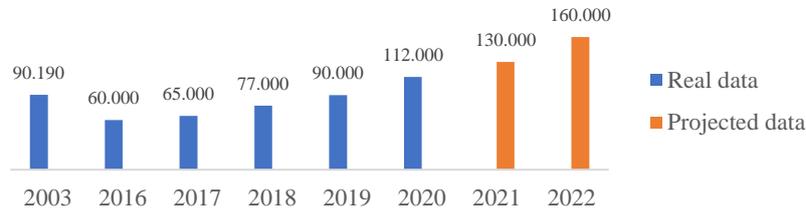


Fig. 1. Brazilian Marine Shrimp Production (in tons). Source: Adapted from ROCHA [21]

The positive projections for 2022 show an escalation of the sector with potential for growth and economic development despite the consequences of the pandemic due to the Covid-19 virus (SARS-COV-2), as highlighted by Rocha [21].

Because of the above, this article proposes to analyze the supply chain of an organization specialized in shrimp farming considering the LCP management model to highlight the strengths and vulnerabilities related to the shrimp farming process in the ponds highlighted case.

2 Supply chain management

The management of supply chains presents complexities in the interrelationships between its members and its production processes. To achieve the defined strategic



objectives, supply chains are having to rethink their management mechanisms [7], [25].

A common concern in the management of supply chains is the aspects responsible for their operation, such as cooperation and integration [1], flexibility and resilience [11], technological level and innovation [22] and ability to manage the associated risks [6].

For Bhatia and Janardhana [1], relationships between chain members are paramount for the proper functioning of their operations, as their absence would imply a drop in the level of customer service, high associated costs, risk financial performance, and the strategic objectives of the chain.

Flexibility and resilience concern the reaction of companies to changes and unwanted events and how they position themselves in the face of these challenges [11]. These capabilities are closely related to risk management, as this function is responsible for evaluating the internal and external environments of the chains to predict such events and minimize their damage once they occur, as highlighted by Corrêa [6].

The importance of managerial dimensions in supply chains was evidenced in the pandemic caused by the virus (SARS-COV-2), which tested organizations' ability to deal with adversities, many of which are uncontrollable, including in the shrimp farming sector [21], which comprises the object of analysis of this study.

Another aspect that requires emphasis, among the managerial dimensions in supply chains, is the technological and innovation level, as Santos, Ruggero, and Silva [22] discussed. According to the authors, investment in technological innovations contributes to increased productivity, greater generation of value for the product, and, consequently, for the customer throughout the production process through the digitization and integration of its processes.

Hence, concerning supply chain management, this article addresses the model of Lambert, Cooper, and Pagh [13]. A tool that allows understanding of supply chains from three perspectives: (i) their structural dimensions, (ii) their business processes, and (iii) their management components, as shown in Figure 2.

By analyzing the structure of the chain, it is possible to identify the leading players and their primary and supporting members. Moreover, the tool assesses the positioning of the focus company (central member of the chain) concerning the other members to identify and prioritize its strategies, based on the degree of importance between each link and direction of the chain. Meaning of supplier or customer sense [4].

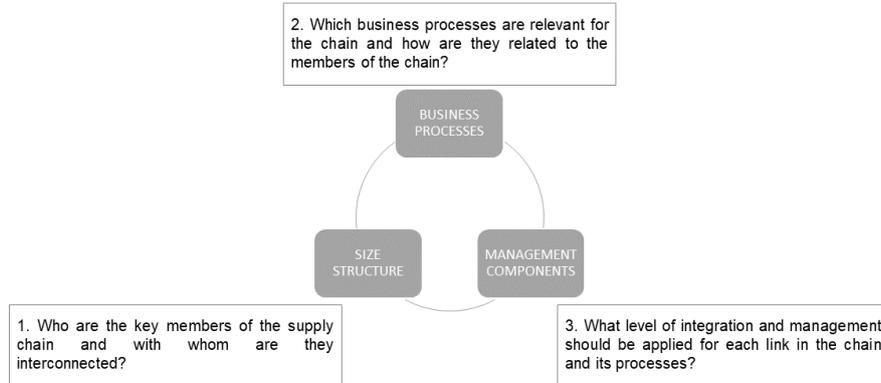


Fig. 2. Dimensional understanding of the LCP model. Source: Adapted from Lambert, Cooper and Pagh [13]

The model lists eight main generic business processes observed in supply chains regarding the evaluation of business processes. However, assessing their processes should not be limited to these but rather take them as a basis. They are Customer Relationship Management; Customer Service Management; Demand Management; Order Fulfillment; Production Flow Management; Supplier Relationship Management; Product Development and Commercialization and Return Management [12], [13].

Demand management makes it possible for the needs of agents to be met, avoiding operational disruptions in the chain. Being an attribution given to the Production Planning and Control function [16], [17].

The correct management of the production flow within a production system is crucial to defining the best sequence that optimizes the manufacturing process, while contributing to its operational efficiency, avoiding waste of resources, and consequently reducing costs [2]. A healthy relationship with its suppliers is undeniable to guarantee an environment of cooperation and unity, principles that characterize supply chains [23].

The development of products and improvements in their functional structures are aspects inherent to organizational strategies in search of market positioning and gains in competitive advantage, impacting their sales, as reasoned by the authors Varnier, Fettermann, and Merino [28].

The last dimension of the model to be evaluated is the chain's management components, responsible for attesting to its level of cooperation and integration [12]. Consistent with the authors, the management components ensure the harmony and proper functioning of the business processes in the links of the chain and are crucial for the development and operational success of this type of organizational structure.

3 Methodological procedures

Regarding the materials and methods of this article, this discussion begins with the characterization of this study in terms of its nature, methodological approach, and adopted empirical investigation method. In this sense, this work can be understood as a case study of an applied nature, conducted under a qualitative approach regarding data treatment and analysis of the findings. This classification is supported by Miguel [15], who considers an applied study to be any investigation involving the practical application of a body of knowledge and theories.

The adoption of this scientific research method is strongly linked to the use of a qualitative approach to deal with the findings, as it uses verbal, visual, and/or documentary evidence to understand a phenomenon in-depth, especially when it does not allow the construction of a numeric association that represents the causal relationships between the elements (variables) that describe it [15].

The systematic characterization of the case study denotes the need for well-structured procedures to achieve the objectives outlined, and the following methodological approaches are then adopted:

(i) Bibliographic review: this step is essential in all scientific research as it forms the basis of the theoretical-conceptual model that will underpin all the following discussion of the work [26]. We searched for results in indexing databases of scientific material, such as Academic Google, Scielo, Scopus, and Web of Science, with the search term 'Supply Chain Management'. To discover works carried out in other segments, the search was not limited to the term 'shrimp farming';

(ii) Data collection: at this stage, we sought to collect the organization's operational and managerial records, which would allow for the understanding and subsequent analysis of the chain. To this end, document analysis was used as an information collection tool, in addition to three unstructured interviews with the organization's managers: the Fishing Engineer, responsible for the production process (with five years in the company), and the Administrator (with three years in the company);

(iii) Data analysis and presentation of results: the information collected was analyzed from the LCP supply chain management model, which allowed the study of the multiple dimensions that make up this type of organizational structure. For the synthesis and analysis of these collected data, the SWOT Analysis (Strengths - Weakness - Opportunities - Threats) was used, making it possible to highlight the strengths and weaknesses of the organization, from the critical analysis of its internal and external environments [8], [18]. The results are presented in the next section.

4 Results and discussions

4.1 Dimensional structure of the chain and its characteristics

The chain under analysis can be understood from the structure presented in Figure 3. Where the members that compose it are highlighted. Within a horizontal-vertical analysis of the chain, their different types of process interconnections infer which are the most critical processes for the focus company and which require greater prominence on its part.

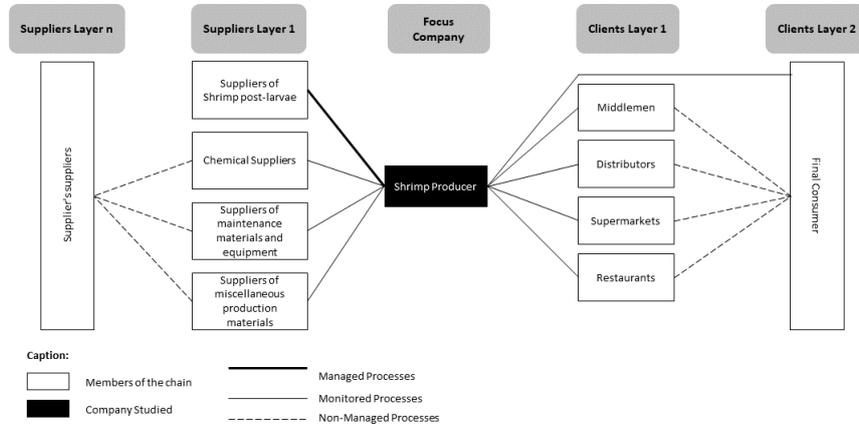


Fig. 3. Dimensional structure of the shrimp farming chain.

Figure 3 shows the main links in the shrimp farming supply chain: the analyzed company is the core of the chain, the equipment, and input suppliers comprise the main link backward, and the main connection forward is formed by intermediaries, retailers, distributors, and individual consumers. Solid lines represent direct relationships between links in the chain, while dotted lines connect indirect stakeholders.

As for backward linkages, it is essential to point out that shrimp production occurs on a relatively small scale, and equipment and input suppliers cannot plan their sales beyond the medium term. The most important inputs are seeds (shrimps in the post-larvae state), chemical products (lothar powder, potassium chloride, sodium bicarbonate, among others), lime, sand, filters, wood, fuels, lubricants for pumps and vehicles.

Local sellers or intermediaries buy directly from farms and are important actors in this chain, as they have access to markets, set prices, and payment methods with the company. These intermediaries usually transport the product in pickup trucks using coolers and it is delivered to formal customers (supermarkets, fishmongers, restaurants, etc.).

One aspect that deserves to be emphasized in this chain is the scarcity of processing activities. Consequently, shrimp are sold without undergoing any significant transformation after creation or manufacturing, which diminishes their added value.

Concerning the characterization of the focus company, it operates in the creation of saltwater shrimp of the species *Litopenaeus vannamei* (white shrimp or gray shrimp), located in northeastern Brazil. Regarding its organizational structure, it is composed of three main sectors, namely: administrative, production, and commercial. Despite being considered a small company, with a staff of only 15 employees, it has an average production of 21,000 kilos of shrimp per production cycle (100 days) from three farms.



Its supply chain involves a network of suppliers, constituted by companies located in several cities in the states of Paraíba and Rio Grande do Norte, in northeastern Brazil. These are responsible for inputs such as post-larvae, tools, fertilizers, lime, chemical products, hydraulic and electrical materials, among other needs for the company's production operations.

The cultivation system adopted in the studied company is the semi-intensive one. This model is technologically more advanced, with periodic monitoring of the physical and chemical parameters of the water, periodic sampling of shrimp growth (biometrics), and concentrated feed, resulting in higher productivity.

The production flow is composed of macro processes: 1. The **preparation** of ponds consists of drying them so that the soil is exposed to solar radiation for at least ten days, and undesirable aquatic microorganisms can be eliminated. Finally, the ponds are filled again to start a new cycle; 2. In the **post-larvae** purchase phase, price, delivery, and quality are considered in their impact on shrimp survival; 3. The **nursery** process is indicated only when there are problems with the adaptation of shrimp in the ponds, causing a high mortality rate for the species. To avoid this problem, the post-larvae are placed in pre-nursery tanks (nurseries) with specific water conditions that guarantee greater adaptation to the fattening phase in the nurseries; 4. The **ponds** are stocked with post-larvae from commercial laboratories in the stocking process. In the semi-intensive system, it is recommended not to exceed the proportion of 10 post-larvae/m² in fattening ponds; 5. **Fattening** is the stage responsible for the growth of shrimp to size for commercialization. 6. Finally, **harvesting and delivery** to the customer is the step that alludes to the operation of removing the cultured shrimp from the pond when it reaches the commercial size of 10 grams.

4.2 Assessment of business processes

The business process approach optimizes the product flow by facilitating the exchange of information between companies [12]. However, the analysis of all these processes is not an easy task, and their integration and management may even be infeasible or inappropriate, according to the authors. Therefore, the analysis of the analyzed supply chain business processes considered the dimensions of the LCP management model.

In demand management, it was observed that there is no structured production planning function, and demand forecasting tasks are not performed. Making the entire production system susceptible to unpredictability and market dynamics.

The management of the manufacturing flow occurs without many complexities, as it is a simple production process so it is not concerned with flow optimization mechanisms and studies of methods. Being restricted only to studies of investments in technologies for the sector.

Concerning the management of Relationships with Suppliers, the company does not have a strategic plan. Nevertheless, the impact of any eventuality and/or materialization of a risk to the chain will be substantial for the process. There is also no after-sales relationship with customers.



Regarding the development of the Product and Commercialization, it is observed that it is a product without many complexities, but there are two problems of interest in this discussion: its life cycle, as it is food sold in nature, is highly perishable and requires an efficient logistics strategy to ensure prompt delivery to the consumer; and the high mortality rate in the production phase, requiring greater care and investments in technologies by managers. Although there are risks, the company disclaims any liability for the delivery.

4.3 Assessment of chain competencies and their management components

When evaluating the skills of the chain, it was analyzed, among other aspects, its technological level, coordination, and cooperation. The focus company has a system that controls biometrics, expenses, and billing. Additionally, it has a system for issuing invoices and monitoring accounts payable and receivable through electronic spreadsheets. However, these systems have no integrated communication, and some information is not reported to administrative employee, making it difficult to correctly monitor information, especially billing and accounts receivable issues.

Managerial planning, operational controls, and information exchange are restricted to internal flows only and incipiently. Only the decision-making report is executed for suppliers, mainly related to the number of inputs and materials to be acquired.

By deepening the discussion, it is understood that flexibility in the supply chain is associated, among other aspects, with the responsiveness of its agents, in the face of unusual events, without compromising the level of service offered by the chain. Therefore, integration and operational harmony between its links are necessary [11].

However, it is noted that the supply chain under analysis is formed by a low level of integration between members and little or no efficient demand management, causing the company to be strongly impacted by any eventualities that affect the supply chain.

Concerning its management components, the need to adopt a model that manages network relationships and processes is indisputable. To this end, the LCP model proposed by Lambert, Cooper, and Pagh [13] proves convenient when managing the fundamental aspects of the chain.

The level of chain integration is defined based on the number of managerial components assumed. For the company under study, the elements identified were: workflow structure, organizational structure, product flow structure, leadership, power structure, and management methods, although some of these do not have a well-defined structure. In Chart 1, it is observed concisely, the description of the guiding elements of the LCP management of the supply chain inserted.

Chart 1. Main points of the supply chain analysis.

Guiding Elements	Analysis		
The supply chain structure	Activities	Primaries	Receipt, transport, and storage of raw material (shrimps in post-larvae state, chemicals for the maintenance of shrimp farming, lime, sand, filters, wood, fuel, and lubricants for pumps). Transport carried out by own vehicles.
		Support	Sales planning is done by the administrative sector of the focus company, with shrimp being sold to traders. Shrimp are raised and fattened by the production sector. The focus company's commercial sector also maintains relationships with restaurant owners.
	Dimensions	Horizontal:	Equipment and input suppliers comprise the main link backward, while the main link forward is composed of intermediaries, retailers, distributors, and individuals.
		Vertical	In the first layer are the suppliers of post-larvae, chemical products, pool maintenance equipment, and various materials for production.
	Processes	managed	The focus company manages only the post-larvae company processes of the first-tier suppliers.
		monitored	Except for the post-larvae company, the first-tier members and the second-tier consumer have only monitored processes.
The key business processes	key elements		Key business processes are considered to be the entire management from the production stage to the sale of shrimp to the consumer.
Supply chain management components	Business process assessment		The management of the relationship with the internal and external customers is done through telephone contact. Demand and production flow management is carried out under market requirements. There are no agreements or risk policies and appreciation campaigns for employees.

4.4 SWOT Analysis of the organization and its environments

Based on the analysis of the dimensional structure of the chain, its business processes, and management components, it was possible to build the SWOT analysis of the focal company, as shown in Chart 2 below.

Chart 2. SWOT analysis of the focal company concerning the supply chain.

	Forces	Weaknesses
Internal environment	<ul style="list-style-type: none"> • Small company, but with considerable production (average of 21,000 kilos of shrimp per production cycle). • The cultivation system adopted in the studied company is semi-intensive, resulting in higher productivity. • Production flow management is simple and does not require flow optimization mechanisms and method studies. • Focus on studies of investments in technologies for the sector. 	<ul style="list-style-type: none"> • Shrimp production takes place on a relatively small scale. • The absence of shrimp processing activities reduces its added value. • The Production Planning and Control function is not structured. • There is no strategic plan for managing supplier relationships • Lack of integrated communication of the company's financial and billing systems. • Management planning and information exchanges are restricted to internal flows only and incipiently.
	Opportunities	Threats
External environment	<ul style="list-style-type: none"> • Equipment and input suppliers plan sales in the medium term. • The supply chain involves a network of suppliers responsible for the main inputs, in a nearby location, in the Brazilian Northeast. 	<ul style="list-style-type: none"> • Intermediaries are important actors in the chain, as they have access to markets, set prices, and payment methods with the company. • Intermediaries usually transport the product in pickup trucks and coolers to formal customers. • Low level of integration between the members of the analyzed chain. • Absence of well-defined structure on workflows and product, organizational structure, leadership, management methods.

The SWOT matrix shows the care given by the company in its operational activities, resulting in good productivity, and pointing out the need for a greater focus on integration and coordination actions in the relationships of the analyzed chain.

5 Final Thoughts

This article aimed to analyze an organization's supply chain specialized in shrimp farming from what the LCP management model preaches. It was possible to use the concepts of the model to map and understand the chain, its structure, and relationships, as well as its business processes and management components, to analyze its strengths and weaknesses.

It is noteworthy that the cultivation system, the use of own resources, and well-established stages in raising shrimp in ponds are considered positive factors in the company.

Furthermore, it was possible to identify points of managerial inefficiencies in the chain, which were presented to managers, reiterating the practical contribution of this article to the shrimp farming sector, especially for the company object of this study.

Regarding the management components of the analyzed chain, the need to adopt a model that manages the details, the relationships, and the processes of the network is indisputable.

As a limitation of this work, the study was conducted amidst the global pandemic caused by Covid-19, which made it impossible to visit all the company's breeding farms. Viewed in this way, this article was limited to understanding only the main links in the chain and business processes of the focus company.

For future work, it is suggested to expand the scope of the analysis and evaluate issues such as the impact on the lack of relationship and integration for the chain; a proposal to improve the internal and external demand management process; and the analysis of performance indicators in the supply chain operation.

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