



## MAPPING AND ANALYSIS OF THE SUPPLY CHAIN: A CASE STUDY IN FOOTWEAR INDUSTRY

MAPEAMENTO E ANÁLISE DA CADEIA DE SUPRIMENTOS: UM ESTUDO DE CASO NA INDÚSTRIA CALÇADISTA

MAPEO Y ANÁLISIS DE LA CADENA DE SUMINISTRO: UN ESTUDIO DE CASO EN LA INDUSTRIA DEL CALZADO

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### ABSTRACT

Given the current scenario of intense competition among organizations in the market, performing well-structured planning becomes increasingly important for the survival and success of organizations. In this sense, supply chain management allows for coordinated management of the relationships between partner organizations, in order to create value for products and services, reducing associated costs. The present study was conducted in a footwear industry located in the state of Paraíba and aimed to map and analyze the organization's supply chain, aiming to build structures that allow a systemic view of suppliers and customers, enabling better management and control over production and logistics processes. For this purpose, data collection was carried out both in the organization under study and in partner organizations, focusing on the analysis of relationships and their specific characteristics. The results allowed mapping and analyzing the organization's supply chain based on several aspects, enabling an oriented management and better control of associated logistic risks.

### RESUMO

Com o atual cenário de ampla competitividade entre as organizações no mercado, realizar planejamentos bem estruturados se torna cada vez mais importante para a sobrevivência e o sucesso das organizações. Neste sentido, a gestão da cadeia de suprimentos permite uma gestão coordenada das relações entre organizações parceira, com o intuito de criar valor aos produtos e serviços, reduzindo os custos associados. O presente estudo foi realizado em uma indústria calçadista localizada no Estado da Paraíba,

e teve o objetivo de mapear e analisar a cadeia de suprimentos da organização, visando construir estruturas que permitam uma visão sistêmica dos fornecedores e clientes, viabilizando a execução de uma melhor gestão e controle acerca dos processos produtivos e logísticos. Para isso, foi realizada uma coleta de dados tanto na organização objeto de estudo, como em organizações parceiras, com foco na análise das relações e de suas características específicas. Os resultados alcançados permitiram mapear e analisar a cadeia de suprimentos da organização com base em diversos aspectos, viabilizando uma gestão orientada e um melhor controle dos riscos logísticos associados.

### RESUMEN

En el actual escenario de amplia competitividad entre las organizaciones en el mercado, realizar planificaciones bien estructuradas se vuelve cada vez más importante para la supervivencia y el éxito de las organizaciones. En este sentido, la gestión de la cadena de suministro permite una gestión coordinada de las relaciones entre organizaciones asociadas, con el fin de crear valor a los productos y servicios, reduciendo los costos asociados. El presente estudio se llevó a cabo en una industria de calzado ubicada en el estado de Paraíba, y tuvo como objetivo mapear y analizar la cadena de suministro de la organización, con el fin de construir estructuras que permitan una visión sistémica de los proveedores y clientes, permitiendo una mejor gestión y control de los procesos productivos y logísticos. Para ello, se realizó una recopilación de datos tanto en la organización objeto de estudio como en organizaciones asociadas, centrándose en el análisis de las relaciones y sus características específicas. Los resultados obtenidos permitieron mapear y analizar la cadena de suministro de la organización en función de diversos aspectos, permitiendo una gestión orientada y un mejor control de los riesgos logísticos asociados.



## 1. INTRODUCTION

In the current scenario, competitiveness is increasingly accentuated in the markets, making it necessary to plan well-structured management of an organization. One of these factors that must be present in any company is supply chain management, as it encompasses the flow of essential elements for the production and distribution of a product or service, generating a cycle between suppliers and customers.

Supply Chain Management aims to satisfy customers with the possibility of meeting their requirements more quickly, aiming both at lower logistical costs and at improving the quality of products and/or services offered (Dutra et al., 2018). In addition, this process is essential to reduce failures and interruptions in production through the exchange of information between all sectors of the organization, enabling structured action.

The main elements that make up the supply chain include the order fulfillment process, which involves customers with needs to be met, stores and retailers supplied by distributors and, finally, industries that supply products to distributors and receive raw materials from others. suppliers (Chopra & Meindl, 2016).

It is important to emphasize that logistics is an area of extreme importance for supply chain management. Its concept involves managing the movement of people, materials and products from one location to another, according to the needs of the Members responsible for meeting customer demand. Logistics ranges from the acquisition of inputs to delivery to final consumers (Silva, 2016).

Considering that inventory is generated at many stages of the supply chain, it is crucial to know how to manage it properly so as not to compromise product availability or increase costs (Chopra & Meindl, 2016). If inventory planning is inadequate and there is a lack of raw materials, components or even the products themselves in any part of the chain, conflicts can arise between the parties involved.

Furthermore, demand forecasting is a crucial factor that the organization needs to consider. According to Taylor (2005), forecasting demand helps to reduce uncertainties, especially when performed in conjunction with commercial partners. Establishing the quantity of products to be ordered in a given period of time is a difficult task, and the forecast made by each member of the chain increases the chances of getting closer to reality.

Thus, the justification for the present study is given, mainly, by the need to expand the knowledge on the subject presented and apply it in a real company to consolidate the theory. This highlights the importance of managers seeking to optimize the management of their supply chain. The study was carried out in industry X (so called for reasons of confidentiality of the organization), which refers to a company in the footwear sector located in the state of Paraíba.

The present study aims to proceed with a mapping and analysis of the supply chain of an organization in the footwear sector, aiming to build structures that allow a systemic view of



suppliers and customers, enabling the execution of better management and control over their production processes and logistics.

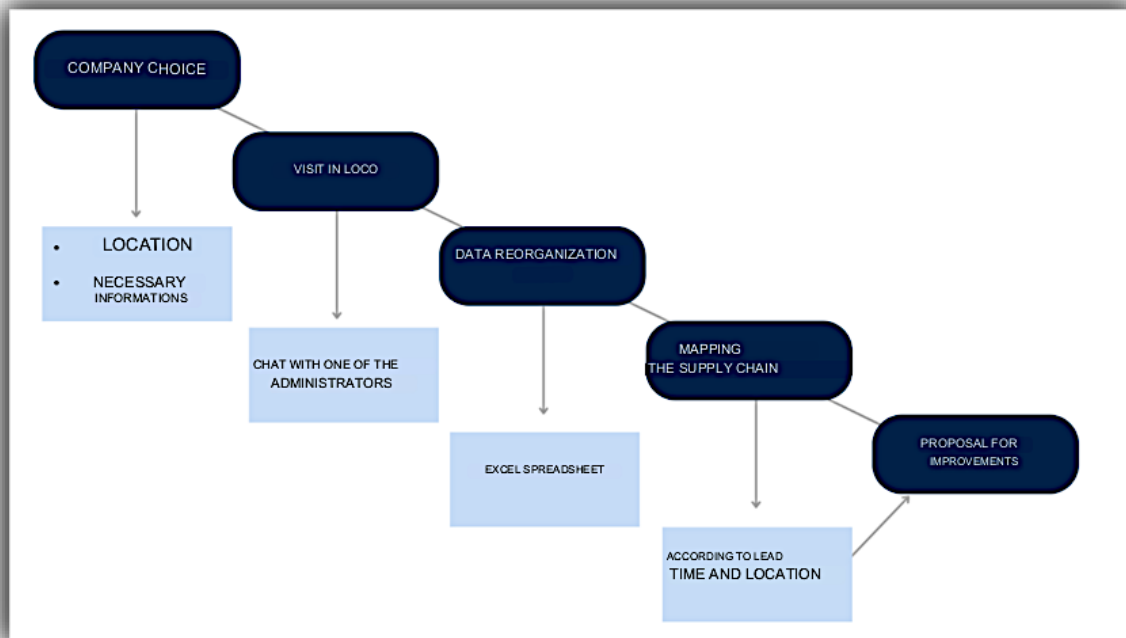
## 2. METHODOLOGY

The main objective of qualitative research is to conduct the progression of studies that seek answers about a given situation, facilitating the understanding and interpretation of facts, without the intention of using numerical data (Proetti, 2018). In view of this, the present work is a qualitative research of an exploratory nature, in which a detailed analysis of the company was carried out between the months of November and December to observe how its supply chain works.

The criteria used to choose the company are related to its location and its importance in the industrial sector in question. In addition, as it is an industry inserted in the footwear trade sector, its structure is more organized, enabling access to the information necessary for the development of this study.

On-site visit was carried out to pass on to one of the organization's administrators' which data would be essential for the study. After collecting the data, a treatment was carried out in electronic spreadsheet software, where the supply chain was subsequently mapped, considering the operations, distribution flows, suppliers, delivery lead times, distance between the chain elements, among other peculiarities (Figure 1).

Figure 1. Work methodology flowchart.



Source: Authors (2023).



### 3. THEORETICAL FRAMEWORK

The term logistics has been used for a long time, but over the years this concept has been improved. With the increase in market competitiveness, other perceptions were attributed to logistics. Therefore, it is responsible for planning, implementing and controlling the flows and storage of finished products, raw materials and information, around the supply chain as a whole, from suppliers to distributors, retailers, consumers, among others. In addition, it seeks to increase the quality, reliability and speed of delivery, minimizing both internal and external costs to the organization (Morais, 2015; Platt, 2015).

Thus, it can be said that in order to achieve these objectives, a good relationship between the components of the chain is necessary, since everyone needs to be informed about the stipulated delivery dates, as well as various other relevant information about the production cycles and distribution, so that planning is carried out effectively.

Thus, when the product or service meets the customers' requirements of being available at the place and time they wish to consume them, there is a greater addition of value and, consequently, an increase in the credibility of the members who make up this whole process (Pontes & Albertin, 2017).

Applying this concept in the business context, some results provided by the integration between logistics and business areas can be highlighted. According to Morais (2015), some of them are described below:

- a. Integration with finance: provides a shorter time for the product to remain in stock, reduces operating costs and establishes policies related to investments, such as the acquisition of equipment, fleet renewal, among others.
- b. Integration with production: minimizes the risk of unwanted stoppages in production by ensuring resource availability, in addition to avoiding waste by controlling operations.
- c. Integration with marketing: through the distribution of products in certain locations, using means to reduce costs, logistics allows the organization to stand out among its competitors, in addition to bringing reliability to its customers, since it ensures that the delivery deadlines are met.
- d. Integration with human resources: establishes the appropriate profile of professionals and designates their training processes, aiming at the use of tools applied to logistics itself.

In view of this, it is noticeable how much organizational logistics directly contributes to business success and advantages in the midst of the competitive market. Misuse of this can lead to high costs, delay in the availability of resources that consequently affect the delivery period and a longer time of the product in storage.



### 3.1. SUPPLY CHAIN MANAGEMENT

The concept of supply chain management consists of managing upstream and downstream relationships with suppliers and customers, with the aim of meeting their needs by delivering products with greater value at the lowest cost for the entire chain (Christopher, 2022). Based on this context, the parties responsible for this process of delivering what was requested have a high relationship with each other, since, if any of them delays the production of the components or service for a certain reason, the entire chain could be affected.

According to Filho et al. (2018), with supply chain management, competitiveness between companies is increasing, mainly due to the need for fast communication and exchange of information between the links that make up the chain for a better efficiency of its operation, many companies are investing vehemently in systems that enable more agile and effective results, elevating the organization to a position ahead of the others.

Until a few years ago, many companies viewed themselves as an independent entity. Nowadays, this vision is completely different, because, over time, organizations have been observing the importance of managing the supply chain in an integrated way, considering all the entities that make up this system to work in line with the full fulfillment of the need of consumers (Souza, Carvalho & Batocchio, 2004).

The management of these chains needs to occur effectively to promote increments in the organization's results, from cost reduction that contributes to increased profitability, such as compliance and minimization of delivery lead time, in order to achieve greater reliability on the part of customers.

This management is characterized by coordinating the flows of sequences of processes and operations that will generate value at the time of delivery of the product or service to the final customer, also seeking to manage the flow of information around the upstream and downstream components (Slack, Jones & Johnston, 2018).

For Chopra and Meindl (2016), the main decision phases in the structuring and planning of a supply chain are:

- a. Supply chain strategy or project: at this point, the company will define how the chain will be structured over the next few years, determining how resources will be allocated and which processes will be carried out at each stage. In addition, at this stage it is necessary to establish whether some functions will be outsourced or produced internally in the company.
- b. Planning: it consists of defining which markets will be supplied and in which locations, the stock policies that will be used, the duration and sizes of marketing actions and price promotions. During this phase, organizations must insert around their decision, the uncertainties of demand and competition during the chosen planning horizon.
- c. Operation: the decisions taken by the company at that time are related to individual customer orders due to the time horizon being weekly or even daily, with the aim of



handling them to arrive at their destination in the best possible way. Some of the activities carried out consist of preparing order picking lists, defining the delivery date for each of them, placing replacement orders, among others.

### 3.2. MAPPING SUPPLY CHAINS

For a good management of the supply chain, it is necessary to carry out its mapping, since it allows analyzing all the suppliers and customers of the company, contributing to the reduction of waste and allowing a greater understanding by the manager, regarding the importance of the elements of the supply chain. chain for the production process. Seeking a broad understanding of the processes that take place along the supply chain is considered an arduous activity, since there is a great deal of interaction between the members that compose it (Ruiz, Mendes & Silva, 2016).

According to Chopra and Meindl (2016), there are two ways of observing the existing processes in the chain, which are the cyclic view and the push/pull view. The first consists of dividing these processes into several cycles. The second is segmented into the categories of pull, when processing takes place from the customer's request, and push, when the company anticipates and performs the procedures before the product/service is requested.

A mapping carried out in a bakery was proposed by Júnior et al. (2019). The study demonstrated a broad ability to visualize the main elements of the chain, allowing to observe which suppliers were located closest to the company, as well as which are its main customers and associated risks. With this, the authors were able to identify how the relationship between suppliers and customers took place, as well as the availability of the establishment to expand its relationship with the other members.

### 3.3. RISK MANAGEMENT IN THE SUPPLY CHAIN

Risk management in the supply chain consists of concern and analysis of possible vulnerabilities and ruptures existing in this set of links, on the part of the company, aiming to use already formulated concepts about risk management to apply them throughout it planning in a way to reduce the probability of these unwanted events to propagate (da Silva, 2018). In another view, it can also be defined as the identification and control of risks that can affect the performance of a chain through coordination and collaboration between members (de Oliveira et al., 2020; Gohr & Silva, 2015).

For Takakura, Vivaldini and Spers (2016), it is necessary for companies to be concerned with the risks arising from all directions, from the external to the internal environment, since business opportunities will arise according to the capacity of this organization manage risks. Most of the natural risks are treated through insurance or diversification and redundancy for the segment, which generate costs that must be accurately analyzed, as well as considering the trade-off between costs and benefits (Pohlmann et al., 2020).

Based on research carried out by Graeml and Peinado (2014), in which they sought to verify the resilience of supply chains in Brazilian companies, by analyzing factors related to risks in supply management chain a positive result was obtained according to the comparison of the





employees' responses through the Likert scale. The points addressed in the structured questionnaire consisted of identifying whether there is high collaboration with customers and suppliers in order to have a transparent chain with high exchange of information, constant monitoring of suppliers, employees specialized in managing risks, among other aspects (Abdellatif & Graham, 2019).

Still in the context of risk management, demand forecasting is a topic that has been progressing over time in supply chain management, in which the aim is to adapt market needs to suppliers quickly and efficiently, in order to align strategically the quantity demanded amid the operational capacity along the entire chain (Melo & Alcantâra, 2011).

According to Silva (2020), as challenging as the supply chain management process is to assertively predict the future demand for the goods produced by the company, whether they are services or products, that is, how much must be produced to be able to deliver the amount the market demands. Furthermore, choosing the best forecasting methods and models can be a complex factor, as it is necessary to consider several aspects that influence product demand and translate the results with the greatest possible reliability regarding future scenarios.

Thus, there are some characteristics about forecasts that need to be considered. Demand forecasting techniques are classified into quantitative and qualitative, in which they have strengths and weaknesses. The first consists of more subjective analyses, while the second uses historical data in order to find correlations with past events. With this, the company has the task of verifying what its needs are and choosing the method that best suits its reality (Staudt, 2011).

The demands may also be dependent or independent. All purchases made by companies above consumers are classified in the first type, such as those that supply raw materials, intermediate products, among others. On the contrary, the independent is related to the demand for the finished product by consumers (Taylor, 2005).

According to Szabo (2016), several factors can influence demand, requiring the company to be aware of these variables to subsequently analyze their degree of relationship with the quantity of products or services required, before selecting the most appropriate method for the situation.

#### 4. COMPANY CHARACTERIZATION

The organization object of study, called "Company X", is a large organization that operates in the footwear sector, located in the state of Paraíba. It has been in the market for 15 years, having as its main economic activity the manufacture of shoes and as secondary activities the manufacture of clothing accessories, plastic products, cutlery and hand tools and sells, wholesale or retail, footwear, clothing and accessories.



It currently has 2100 employees and its main products are sandals and sneakers. Sandals are the company's best-selling items throughout the country, from large to small stores, mainly in the Southeast region.

## 5. RESULTS

Based on the information collected in the company, as well as through the systematic observations made, it was evidenced that production occurs both in a pulled and pushed way. In view of this, the demand forecast is carried out according to the organization's sales history, in addition to analyzing the promotion inputs, that is, the quantity of products consumed in each promotion carried out. With regard to inventory management, a system is used to control the payment of the raw materials needed to manufacture the products and their receipt.

To process orders, the company makes a comparison between the volume in stock and the demand forecast, since, if the stock is smaller than the data obtained in the forecast, a purchase order will be included in the system and sent by email to suppliers.

Currently, the organization's relationship management with its suppliers and customers comes from a forecast, that is, based on the volume forecast. In this way, a margin of what will be needed is identified and passed on to the members of the chain, in order to adapt to the supposed volumes demanded in the next demand cycles. With regard to the exchange of information between the company and suppliers, it was observed that it is based on emails, text messages via applications and, if an immediate and urgent response is required, telephone calls.

### 5.1. SUPPLY CHAIN CONFIGURATION

For a better study and analysis of the supply chain of the organization object of study, a flowchart was initially created, in which the necessary information was added to be able to observe how the distribution occurred in the supply chain of the industry where the company's suppliers are inserted, being these are mainly responsible for supplying raw materials to carry out operational activities internally.

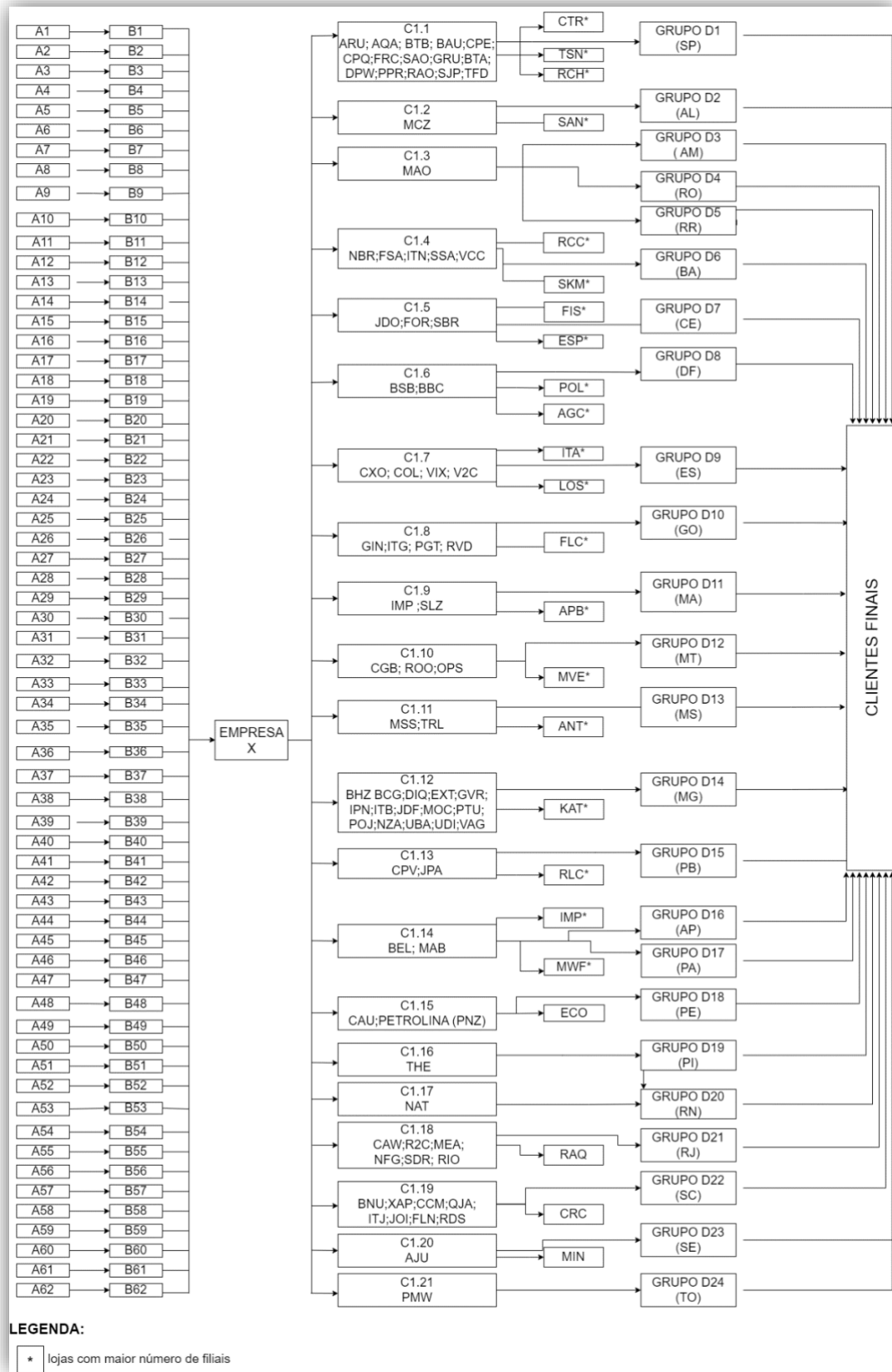
By obtaining the data, it was possible to analyze how the delivery of the finished product to the final customer occurred, where it passes through the various distribution centers ( $C_n$ ) partners. After arriving at the respective distribution centers, the goods are distributed to large shopping centers and small stores, where they reach consumers.

As can be seen in Figure 2, there are a total of 74 (seventy-four) raw material suppliers for the company, 21 (twenty-one) distribution centers, 24 (twenty-four) branches, in addition to several stores and small retailers, which are part of the distribution flow across the country (Figure 2).





Figure 2. Initial supply chain setup.



Source: Authors (2023).



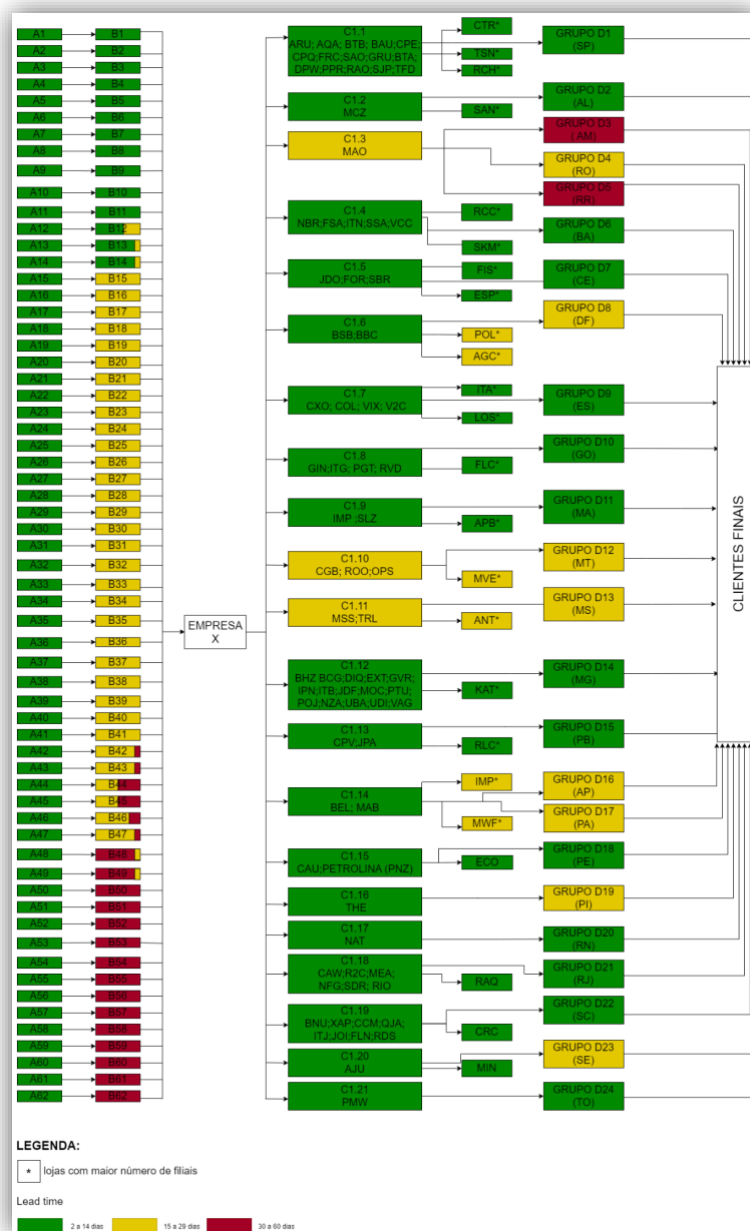
## 5.2. MAPPING AND ANALYSIS OF SUPPLY CHAIN STRUCTURES

### 5.2.1. CHAIN MAPPING BASED ON LEAD TIMES

After assembling the flowchart, a mapping of the supply chain was carried out through the leads time at each stage, from the suppliers that provide inputs to the suppliers of the company under study, passing through the distribution center and retail sectors until reaching the final customer.

For better identification, colors were filled in to list the fastest deliveries ranging from two to fourteen days, which are filled in in green, the intermediate lead times (LT) ranging from fifteen to twenty days (identified in yellow) and, finally, between thirty and sixty days are the longest delivery times, filled in red (Figure 3).

Figure 3. Chain mapping based on members' lead time.



Source: Authors (2023).



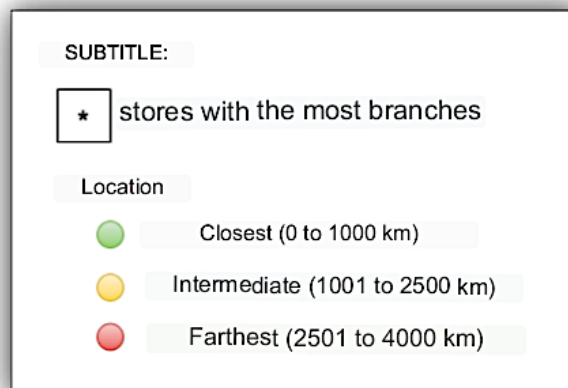
In the first layer there are 16 (sixteen) suppliers that have a shorter lead time (2 to 14 days), and 4 of these supply other inputs that have an intermediate lead time (15 to 29 days) and 2 have a longer lead time in the delivery of other raw materials. In this layer of the supply chain, there are still 35 suppliers that have an intermediate lead time, where 8 supply other materials with a longer lead time (30 to 60 days). The last analysis carried out on Tess' direct suppliers, has 23 companies that have a longer delivery lead time.

Regarding the distribution centers, those located in the North region have an intermediate lead time, the others have a shorter delivery time. Dealing with shopkeepers inserted in the second layer of the chain, there are 14 groups located in different regions, but which have a smaller TL, 8 groups have an intermediate term and only two groups inserted in the capital Manaus have a higher LT.

### 5.2.2 CHAIN MAPPING BASED ON LOCATION

For a more complete analysis of the supply chain, a mapping was carried out according to the location of suppliers, based on the states in which they are located. Initially, a caption presented in Figure 4 was prepared, based on the proximity of the elements in relation to the industry under study, where the green color characterizes the closest member, followed by the yellow color representing an intermediate distance and the green that demonstrates which are located more distant. Finally, the asterisk was used to show the second-tier customers who have the largest number of branches, as well as the large ones. Thus, Figure 5 illustrates the analysis based on the location of the members of the supply chain under study.

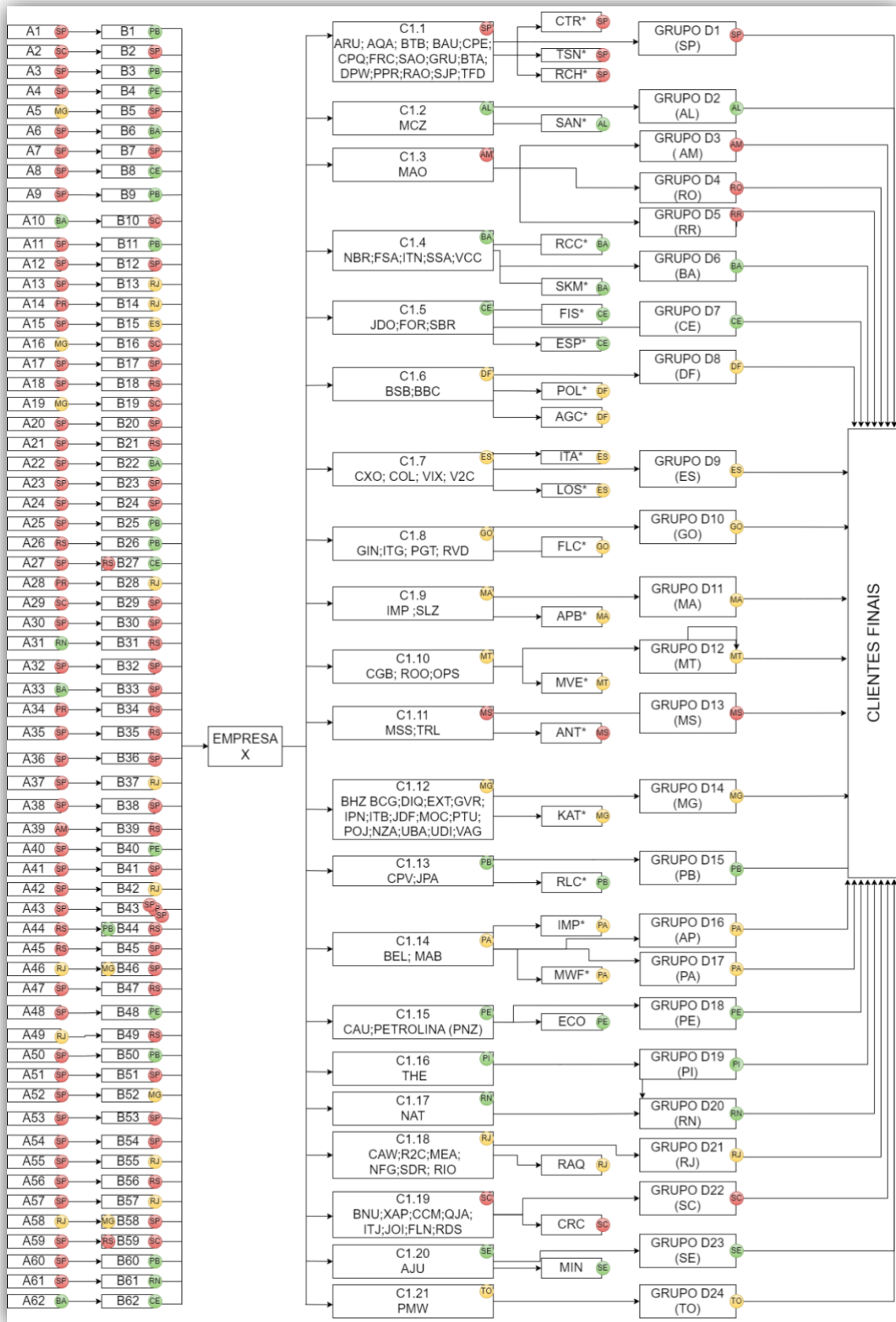
Figure 4. Legend of the mapping according to the location of the members.



Source: Authors (2023).



Figure 5. Mapping according to the location of members.



Source: Authors (2023).



As shown in Figure 5, 45 suppliers located in the first level are located in states that have a distance between 2501 and 4000 km, such as B18 in Rio Grande do Sul, B17 in São Paulo, among others considered distant. In addition, 14 suppliers present an intermediate distance from the company between 1001 and 2500 km, including B52 in Minas Gerais, B71 in Paraná, among others. On the contrary, the 20 closest suppliers are located in the states of Paraíba, Pernambuco, Rio Grande do Norte and Ceará, considering that they are between 0 and 1000 km from the company's location.

Regarding the location of distribution centers C, there are branches in almost all the states where the customers of the industry under study are located, except in Rondônia and Roraima where the stores are supplied by the center of Manaus. There are several stores that are customers close to the industry, located in 8 states of Brazil, highlighting Bahia. Other locations such as Rio de Janeiro and Minas Gerais have 10 groups of stores that sell these products and their distance is considered intermediate.

## 6. FINAL CONSIDERATIONS

For the company to be able to achieve objectives related to the agility of delivery of its products, as well as the reduction of costs, it is necessary to manage the supply chain effectively. In view of this, several types of mapping were carried out, aiming to achieve a broad view of the current reality of the supply chain in question, enabling the execution of process improvements, according to the organizational objectives.

In view of this, when returning to the problem of the research under study, it is noted how important this analysis is carried out in the organization object of study, since it meets the needs of end consumers throughout Brazil, located most of the time away from the company. In addition, as it has a wide range of suppliers, it is essential to visualize which ones have a longer lead time and greater distance, so that the organization can better manage the risks associated with its productive and logistical flows, reducing the possibilities of delays in orders at the links along the chain.

Thus, from the analyzes carried out, it was possible to verify that the organization has a reduced number of suppliers geographically close to it, especially when compared to the total number. Regarding the delivery lead time, most have a period between 15 and 60 days for delivery of the input. Regarding the group of tenants, it was shown that those located in the North region have a higher lead time compared to the others, deserving greater attention in planning and distribution flows.

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