

# Supply Flow Logistics Management Model In The Baking Automation Sector At A Company In Manaus Free Trade Zone

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## Abstract:

**Background:** This article deals with logistics and supply management, a strategic area for companies in today's highly competitive environment. The research targeted a company from the Manaus Free Trade Zone, Amazonas, having as a starting point the finding that there is a logistical bottleneck, with rising supply costs, making material planning even more critical for ensuring an optimal level of production with adequate control of the costs involved. Based on this problem, the following guiding question of the research was elaborated: which "make-to-order" process can be more suitable for company "X", allowing it to balance costs with freight and stock, and at the same time serve the customer on the promised date? Thus, the general objective of the research was defined to propose a logistic management model that allows the optimization of the supply flow in the automation sector of a company in the Industrial Pole of Manaus, based on the cost of stock, time for the acquisition of raw material and the cost of transportation to the plant, with the following specific objectives: to describe the deficiencies of the current logistics management system in the automation sector of company "X"; propose a new management model, focusing on a point of balance between acquisition costs, transport of inputs to the industrial plant in Manaus and storage, and demonstrate how the proposed method can result in competitive improvements for this organization.

**Materials and Methods:** This research was motivated by the need to solve a specific problem, aiming to propose a new management model to contribute to the improvement of practices related to supply logistics, focusing on the scenario of that company where the current model incurs with the current cost of freight due to the difficulties imposed by the business model Make to Order, where purchases of raw materials are only triggered when the company receives the order and this implies logistical difficulties imposed by the company's location.

## Results:

**Conclusion:** The realization of this work allowed, through a case study, to gather enough information to analyze the current situation of a company in the banking automation branch of a company located in the Manaus Free Trade Zone, arriving at a way to minimize costs by doing if the material was available at other company plants in Budapest, Hungary or Chennai, India. With the implementation of these Hubs, the company would be able to serve the customer in less time and at a lower cost.

**Key Word:** Logistics management. Supply. Improvements. Competitiveness.

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## I. Introduction

The supply chain is a key process in the production/distribution of goods and inputs worldwide, this has been a major challenge for all actors involved in this process, in recent years the supply chain has been going through a process of change where it has cost reduction, integration, and agility were sought so that some competitive advantage could be obtained over competitors and thus ensure survival in the market.

This challenge becomes even greater when it comes to the supply chain in the Industrial Pole of Manaus (PIM), due to the distance and difficult access to the capital of Amazonas, which is governed by federal legislation that created the Manaus Free Zone, an area geographically delimited with customs regime and differentiated tax incentives established to promote regional economic development.

Inputs tend to represent a higher cost for the production process, especially when the planning involving their acquisition and transport to the industrial plant for further processing is not carried out efficiently, that is, carried out inappropriately, both about the freight as well as other expenses related to the supply from the supplier to the destination.

This is particularly critical, especially in the case of companies that operate in the Industrial Pole of Manaus, located at an extreme point of the country, in an area where shipments of supplies made in other places

use different modes. When supply planning is not done well in advance, air transport becomes the only solution to streamline it, but this also implies higher costs.

In company "X", which operates in the PIM, the lack of materials to supply the production process is a daily problem, generating difficulty in maintaining the flow of inputs so that production is not affected by stops due to the shortage of raw materials. A way used in the past was to increase the stock level, that is, the inventory value, generating a safety stock. However, this increases inventory costs, which is also a cost that must be controlled very carefully, since the financial resources applied to maintain inventory will have a direct impact on the company's cash flow.

This requires seeking a balance point, where costs are well determined and justified, making the company competitive and surviving the increasingly fierce competition.

In this context, it is observed that, with the global pandemic of Covid-19, the problem of supply logistics has been further aggravated, involving several connected factors: shutdowns of several factories significantly reducing production, flight cancellations, and delay of maritime shipments, among others.

As a result, the problem that company "X" faces today is that there is a logistical bottleneck, with increased supply costs, making material planning even more critical to ensure an optimal level of production with control appropriate to the costs involved.

The focus of the proposed study is the banking equipment automation sector, which, in the case of the company in question, produces according to an order confirmed by the customer (pull production model), which reduces the possibility of acquiring raw materials in advance, an outlet for To minimize this case, a demand was created for products exported to Latin America, for some parts (demand called "Future Mix"), however, this demand most of the time does not cover the real demand, and sometimes the parts indicated for acquisition are not those chosen by the customer. For example, the system may have asked to buy keyboard "x", but the order came with keyboard "y", or the system asks to buy the safe with rear access and the customer ends up opting for front access, as this is a choice of the customer when he issues the purchase order. In this case, a solution created to minimize the problem of customer service time and transportation costs, which should help build up a stock that would help production as soon as the order is finally sent by the customer, ends up causing another problem, which is a surplus of material that, when not used, ends up becoming excess and/or obsolete, at least until an order containing these materials is placed by a customer.

From this problem, the guiding question of the research was defined, which can be summarized as follows: which "make to order" process can be more suitable for company "X", allowing to balance freight costs and inventory costs, and at the same time serve the customer on the promised date?

## **II. Review of Literature**

The PIM is a model introduced by the Federal Government, in the military government that created the Zona Franca de Manaus (ZFM), with three economic axes, commercial, industrial, and agricultural, with the PIM being the sustaining base with 80% of the Gross Domestic Product (GDP) of Amazonas. The ZFM was created in the 1950s through Federal Law n. 3173, of June 6, 1957 (BRASIL, 1957), with the purpose of promoting local development and ensuring national dominance of the region through the integration of the Amazon into the national economy. Bearing in mind the dynamics of investments and their direct relationship with the existence of favorable and stimulating tax conditions, the ZFM was created as an area with a differentiated regime, based on the granting of tax incentives as a form of investment contribution and dynamization of the establishment of companies in the area as a way of inducing local development (ARACATY; BARBOSA; OLIVEIRA, 2021).

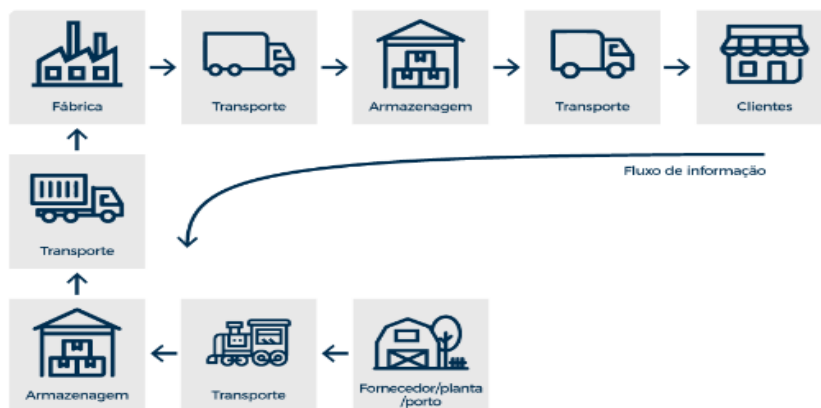
Despite tax incentives, companies installed in the ZFM, in the most recent scenario, have found it difficult to compete with global corporations, which have defined new strategies for the production and distribution of goods and services.

One factor to be considered is the major transformations that the supply chain has been going through, which were driven by the need to implement new technologies in the context of the development of the so-called "industry 4.0", such as the Internet of Things, big data, systems physical-cybernetics, and cloud computing. These technologies, and their subsystems and components, lay a new foundation for full supply chain integration (MARTINS; SIMON; CAMPOS, 2020).

The strategic basis of using these information technologies is the ability to greatly streamline the flow of data, and this is crucial in supply management. Maintaining a flow of information between the links in the chain is a key factor for the efficiency of the processes involved at both ends (requisition and supply of the production line). However, barriers may hinder this data sharing between customers and suppliers (CAMARGO; PIRES, 2021).

When dealing with the strategic management of supply chains based on the so-called "Logistics Model of Uncertainty", focusing on the PIM, Oliveira (2009) identifies opportunities for improvement that can be applied to the Brazilian air modal, mainly

Figure 1 – Cadeia de Suprimentos imediata para uma empresa individual



Source: Ballou, (2001)

### Logistics

For a sole proprietorship operating in a high-end economy, good logistical management is vital. Markets are often national or international in scope, whereas production can be concentrated at relatively few points. Logistics activities provide the bridge between the production site and markets that are separated by time and distance. The mission of logistics is to arrange the right merchandise or service, in the right place, at the right time, and in the desired conditions, while providing the greatest contribution to the company (BALLOU 2001).

### Business Logistic

Business logistics is a relatively new field of management, integrated with the other traditional fields of finance, marketing, and production. As noted earlier, logistical activities have been practiced by individuals for many years. Companies have also been continuously engaged in movement-storage activities (transport-inventory). What is new in these fields results from the concept of coordinated management of related activities, rather than the historical practice of managing them separately, and from the concept that logistics adds value to products or services that are essential for sales and customer satisfaction. (BALLOU 2001).

### Supply Chain

Logistics is a set of functional activities that are repeated many times along the supply chain through which raw materials are converted into finished products and value is added in the eyes of consumers. As the source of raw materials, the factory and the points of sale are not located in the same geographic point and the channel represents the sequence of manufacturing phases, the logistical activities often take place before a product reaches the market. Even there, they are repeated once more when used products are recycled and returned to the logistics channel. A single company is generally not able to control its entire product flow in the channel, from raw material sources to the end point of consumption, although this is an emerging opportunity. For practical purposes, business logistics for individual companies is narrow in scope. Normally, the maximum managerial control that can be expected is over the immediate physical supply, as shown in Figure 1 (BALLOU 2001).

### III. Material And Methods

Regarding the purposes, this research can be classified as an exploratory and explanatory method, as it tries to identify socioeconomic aspects. Also committing to study the necessary actions on the target object in cooperation with those involved considering the possible changes to obtain the desired results.

In this research, a case study was chosen, defined by Bonoma (1985, p, 203) as “[...] a description of a managerial situation”. A company from the Industrial Pole of Manaus called in this study “Company X”.

**Study Location:** The location of this research was in Manaus, Amazon, Brazil. The company manufactures ATMs (electronic teller machines) and supports 10 customers in Brazil.

**Study Duration:** The project was carried out between the years 2018 to 2021.

**Statistical analysis:** The data were entered into a spreadsheet in Microsoft Office Excel 2013 and later, the graphs were plotted through Excel, Minitab, and Software free R.

**Procedure methodology**

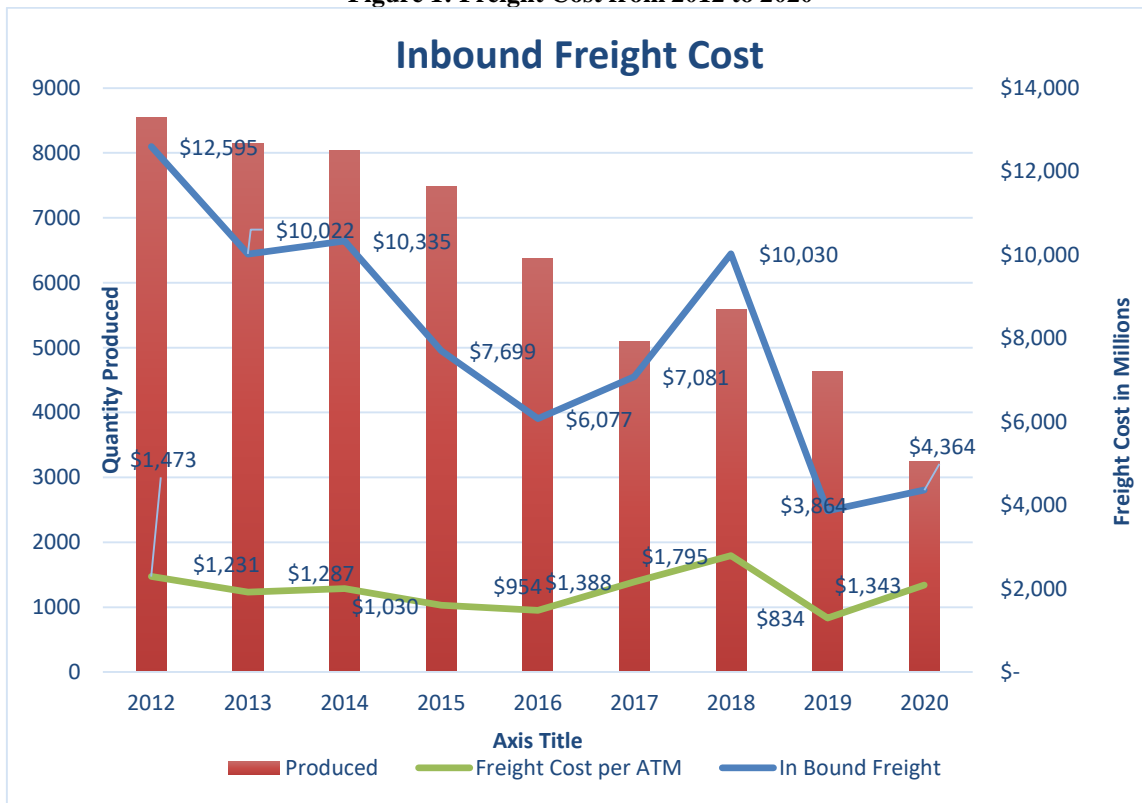
In defining the articles and books that were researched to support this research, the search engine was used, and some topics were placed such as the search period from 2014, although some files with earlier dates were chosen for the relevance of the content, selection by category and selection according to title and abstract. The keywords used were: “Logistics management; Supply; Improvements; Competitiveness.

After selecting the materials by title, the selection was made based on the reading of the abstracts, when the publication was selected, the search for a basis for the study of possible solutions to the problem in question was read, the procedures for carrying out the research, involving sequential actions and chained, planned to achieve the purposes envisaged because of research.

**IV. Result**

The presentation of results was based on data collected from the organization and was submitted to statistical treatment through data tabulation techniques, using the graphics and tables generator program (Microsoft Excel; Software R). The interpretation and discussion of this information were based on the theoretical knowledge presented in the bibliographical review, allowing to base the analysis that will guide the proposal of a new management model, as well as the conclusions of the research

**Figure 1: Freight Cost from 2012 to 2020**



**Source: Elaborated by the authors, 2022.**

In Figure 1, we have the values of expenses with freight in the period from 2012 to 2020. In the analysis, it was possible to identify that in 2012 the largest number of ATMs was produced in the Manaus factory and that in the years 2014 and 2015 there was a considerable reduction in the amounts spent on freight, which were provided by better planning given the number of products signed during the year. This stopped happening after 2018, which also helps to explain the increase in inventory in 2019, with the entry of new models and the uncertainty of new orders, due to this, even so, the freight value was the lowest in the historical series since most shipments were carried out in the maritime modal, which minimizes the amount spent on freight.

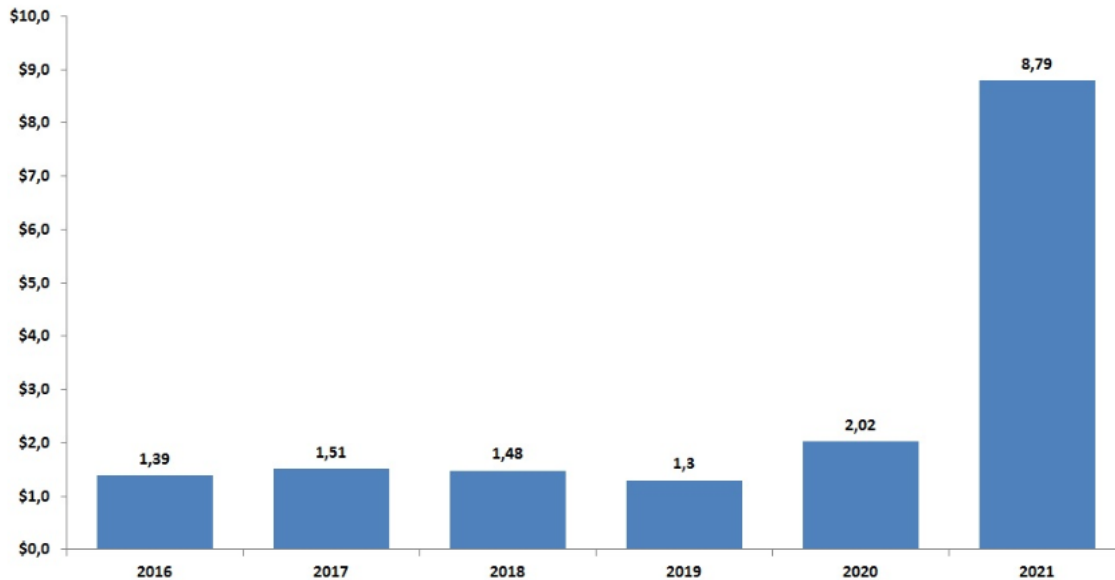
Freight prices also suffer highs and have increased by around 300% since 2020 with the spread of the global COVID-19 pandemic, where we had closed ports and airports and a shortage of raw materials. With the gradual return of activities, the demand for transport and raw materials due to the repressed demand was above what the market could support, thus triggering an increase in the value of raw materials and in the cost of freight to transport these raw materials. In Figure 6, the increase in the average price paid by the company since 2019 can be seen.

Sea freight, which cost an average of USD 1.16 in 2019, rose to USD 1.57 in 2020, which means an increase of 35%, and in 2021, freight cost an average of USD 3.07, i.e. from 2019 to 2021, sea freight increased by 164%, sea-air freight, which is an option between sea and air, where it leaves by sea to Miami and then comes by air to Manaus, cost in 2019 USD 4.1 on average, had an increase of 35% in 2020 and 2021 it started to cost USD 8.38 which means an increase of 105%.

Between 2019 and 2021, air freight increased by 179%, from USD 16.43 in 2019 to USD 19.60 in 2020, and reached USD 45.90 in 2021. is the target of our research.

For comparison purposes, Figure 4.5 shows the prices practiced by the market between 2016 and 2021, prices in dollars per 40-foot container.

**Figure 2: The evolution of the price of transporting a 40-foot container**



Source: Dates of World Container adapted for Farmnews, 2022.

In Figure 2 we can see that freight increases more than 4 times compared to the value observed in 2020 and this lights up an alert for the cost of imported raw materials, this unbridled increase can be explained by a sum of values, among them the increase in demand international trade, especially for commodities and the saturation of ports that operate at the limit of operational capacity and the stoppages during the Covid-19 pandemic have contributed a lot to the current situation, the forecast is that this will last longer, which increases the risks of these highs being felt in the prices of imported inputs.

Figure 3 shows common scenes from 2020, crowded ports as a result of the Covid-19 outbreak, in the picture we see Nansha Port in Guangzhou, China, the stoppage also affected Yantian Port about 80 kilometers north of Hong Kong, which moves goods that would fill 36,000 TEUS (capacity in 20-foot containers) every day, this port was closed for almost a week at the end of May 2021, due to the detection of infections among port operators, after reopening the port continued to operate below capacity, creating a huge backlog of containers waiting to dock.

**Figure 3 – China port during the 2021 Covid-19 outbreak**



**Source: Picture Qian Wenpan/Nanfeng Daily/VCG via Getty Images, 2021**

In Figure 4 we have the amount spent on freight and the amount of raw material transported by modal in weight cubed by the company between the years 2019 and 2021. by air, it's not big, it would be something around 13% less, speaking only of amounts paid, when we check the amount of raw material transported, we find that in addition to paying 13% more to bring it by air, the amount transported is much smaller and not reaches 10% of cargo transported by sea. This further reinforces the need for a change in the way the company's supply chain is managed.

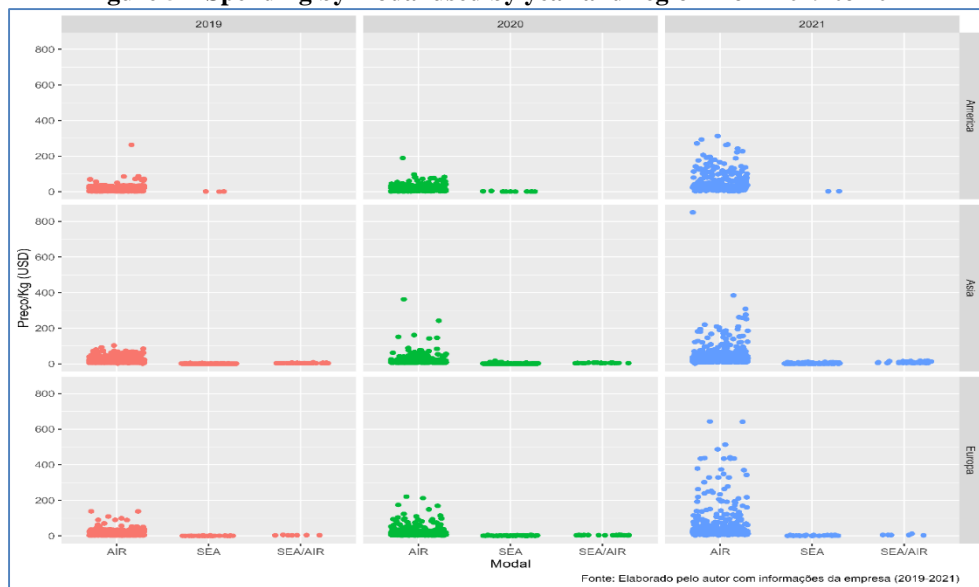
**Figure 4 – Total spend on freight v cubed weight transported from 2019 to 2021**



**Source: Elaborated by the authors, 2022.**

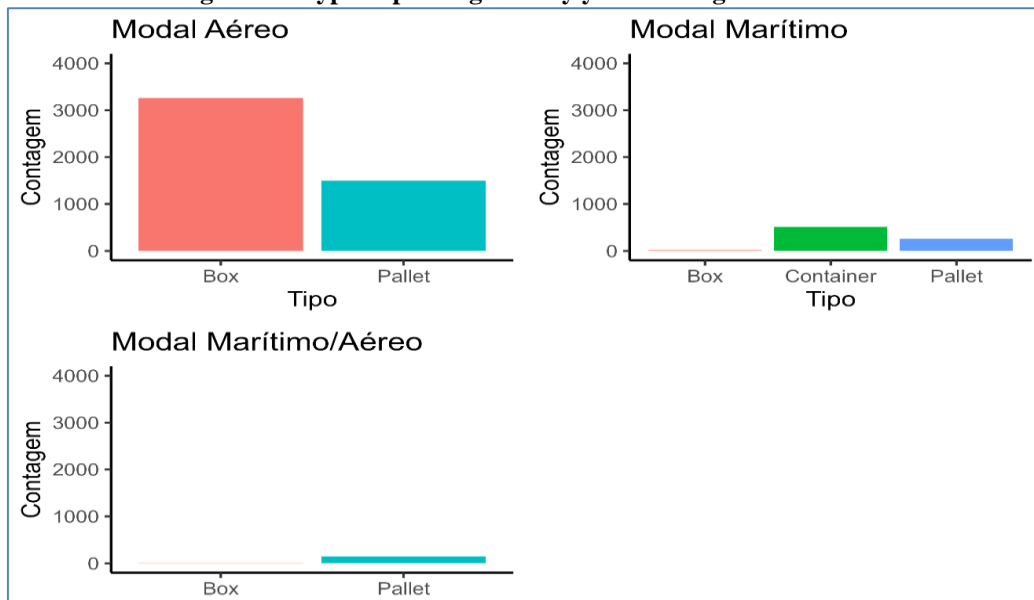
In Figure 5, the graph shows the distribution of modal spending values used by the company divided by continents Europe, Asia, and America. As expected, the amount spent on air freight is much higher than on sea freight, and as shown in Figure 9, the volume transported by sea was much higher.

**Figure 5 – Spending by modal used by year and region from 2019 to 2021**



Source: Elaborated by the authors, 2022.

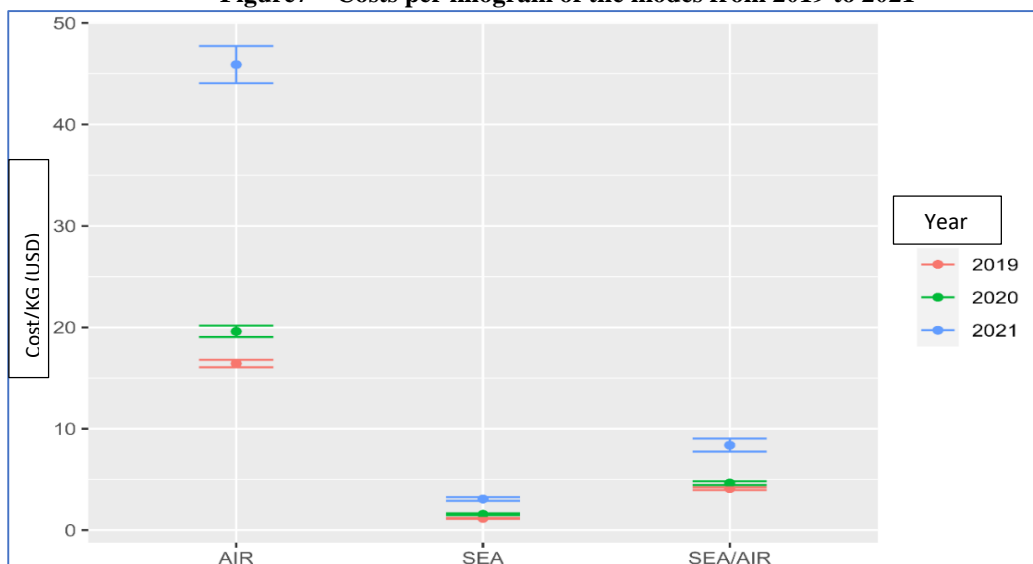
**Figure 6 – Type of packing used by year and region from 2019 to 2021**



Source: Elaborated by the authors, 2022.

In Figure 6 we can see that as in a container we can carry many pieces/pallets, this explains the distribution of Figure 5 which shows a greater use of air modal and which does not occur because many containers are transported in maritime modal and in these containers, we have many boxes and many pallets.

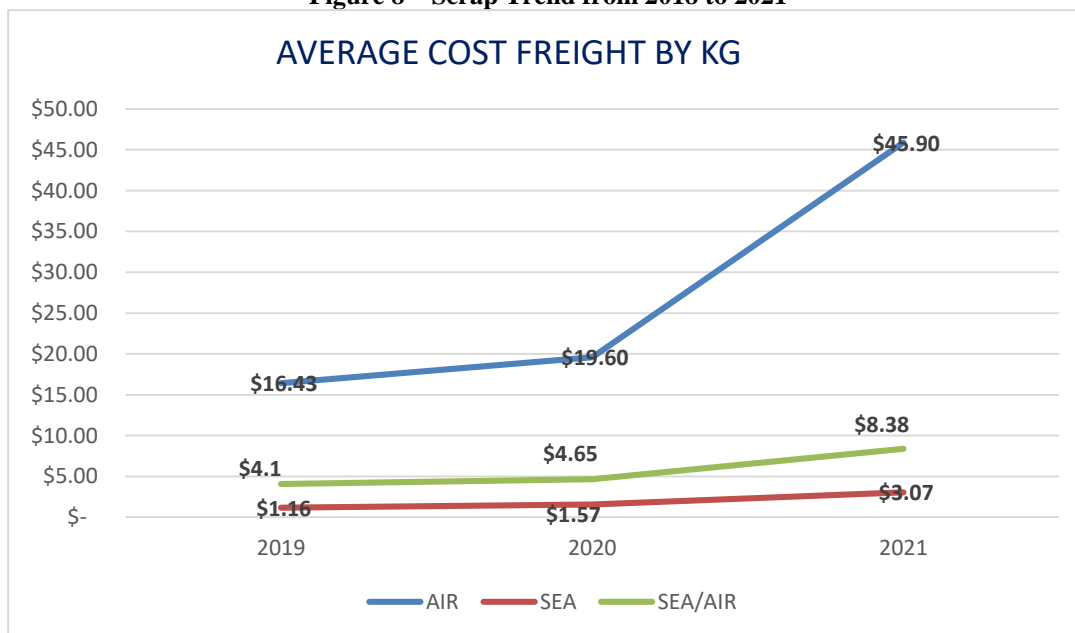
Figure7 – Costs per kilogram of the modes from 2019 to 2021



Source: Elaborated by the authors, 2022.

Figure 8 shows the cost difference in choosing sea or air freight, in 2019, on average, sea freight per kilogram (cube or gross weight, whichever is greater) cost USD 1.16 for a company, and air freight cost USD 16.43 for a company, that is, opting for air transport means paying 1312% more to bring raw materials to Manaus. In 2020, choosing air would cost 1152% more, and in 2021, choosing air would cost 1393% more than choosing sea.

Figure 8 – Scrap Trend from 2018 to 2021



Source: Elaborated by the authors, 2022.

At the beginning of the work, the idea was to create a computer program that would indicate the best option to bring by air or to bring by sea and delay delivery to the customer and pay the fine to the customer, and this might be possible, if not, the increase in delivery time transit to bring material, from Asia for example, took an average of 70 days from departure to arrival at the factory. Today that time has jumped to 100 days on average, which would mean having to bring most items by air, which would mean working with a negative margin or having to readjust the price of the machines or delaying all deliveries and paying fines to the customer, which in addition to hurting the company financially, would also undermine credibility and the relationship with the



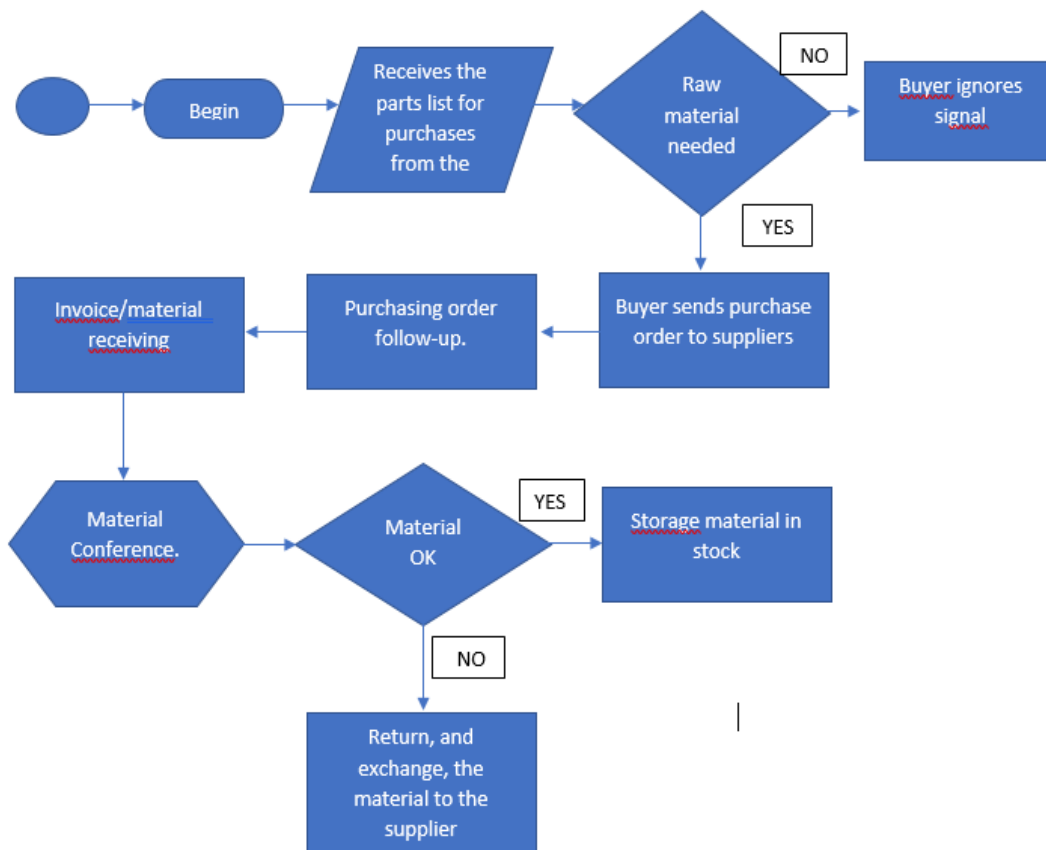
customer over the time. A viable solution to this problem would be the creation of hubs, one in Chennai, India, where the company has a plant that today produces a volume at least 10 times greater than that produced in Brazil. The process would be as follows: all parts purchased from Asia would be purchased from the Chennai company, another Hub would be implemented in Budapest, Hungary to bring materials from Europe, and from then on, not a single purchase order would be placed directly with the trainer, the Manaus would send the demand forecast and the two factories would buy and put it in stock and the item would only go to Manaus when the system based on the determined transit time indicated the need for it. In this way, the items would only go to Manaus in case of need and in case of excess of any item purchased from these plants, they could return without the obligation to pay taxes since it would be a return of material.

This can be done fiscally according to Resolution No. 0010/2015 – GSEFAZ, information valid by the company's tax sector. Another advantage of this process is that the two companies located in Budapest and Chennai can absorb this raw material, thus reducing excess materials globally and improving cash flow.

Returning the material within 180 days, avoiding taxation if, instead of making a sale to another plant, a return is made to the supplier, which with the proposed changes in the supply chain would be the company's plants in India and Hungary.

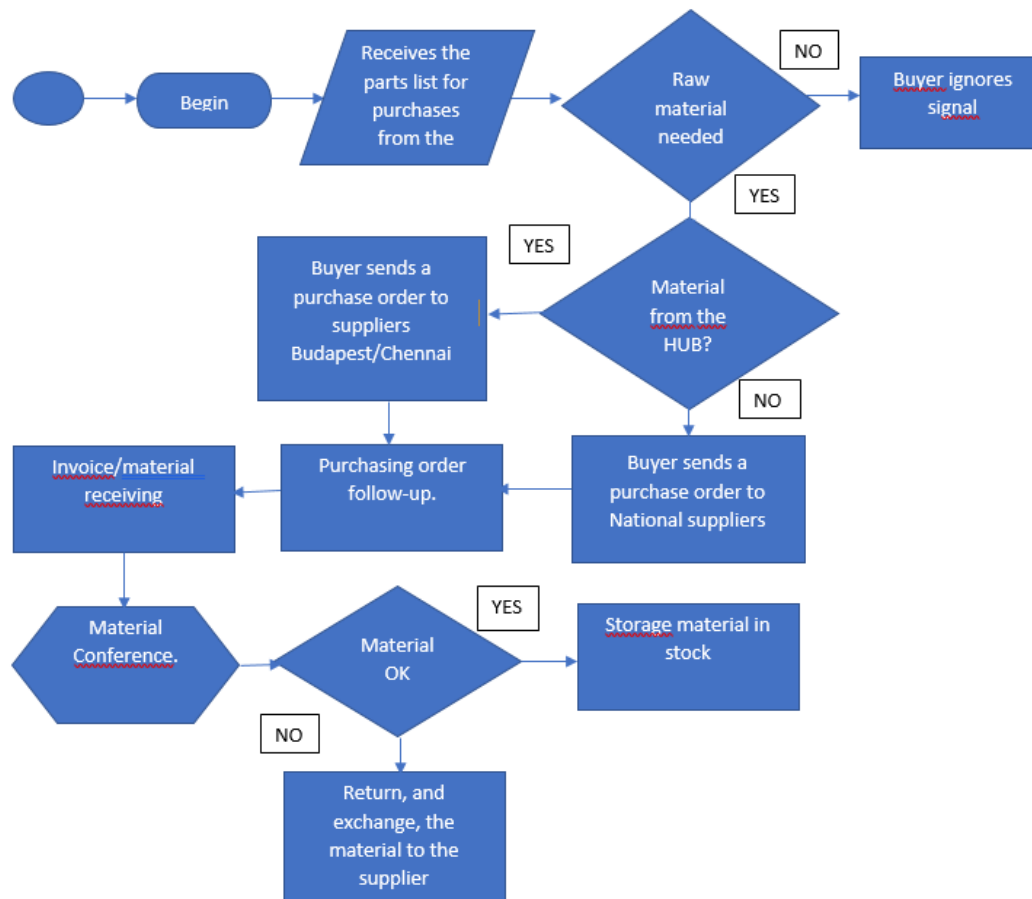
Figures 9 and 10 show the company's process flowcharts, with Figure 13 representing how the process is currently carried out and Figure 14 shows how the process would be after the introduction of the new supply flow logistics management model, the main change would be in the activity of the purchasing team, which, starting from the introduction of the new management model, upon receiving the list of raw materials to be acquired, will place purchase orders for the Budapest unit for items purchased in Europe in general, for Chennai unit for items purchased from suppliers in Asia, and parts that suppliers are located in the Americas including Brazil the purchase order must be sent directly to the suppliers.

**Figure 9 – Flowchart Current Purchasing Process of the company**



Source: Elaborated by the authors, 2022.

Figure 10 – Purchasing Process Flowchart proposal for the company



Source: Elaborated by the authors, 2022.

The factories in Budapest and Chennai will manage, negotiate and maintain stocks of parts using the planning done by the company's planning system, with this the factory in Manaus gains negotiating power because the volumes will be greater due to being negotiated together and the volumes of the plants in Budapest and Chennai are much larger than the volume in Manaus.

**V. Discussion**

The presentation of results was based on data collected from the organization and were submitted to statistical treatment through data tabulation techniques, using the graphics and tables generator program (Microsoft Excel; Software R). The interpretation and discussion of this information were made with the subsidy of the theoretical knowledge presented in the bibliographic review, allowing to base the analyzes that will guide the proposal of a new management model as well as the conclusions of the research.

**VI. Conclusion**

The realization of this work allowed, through a case study, to gather enough information to analyze the current situation of a company in the banking automation branch of a company located in the Free Trade Zone of Manaus. At first, it was thought of working with Artificial Intelligence, making a program that would indicate what would be best, but as delivery to the customer would have a very large weight in the decision, it would be almost certain that 99% of the cases would opt for air freight, that way A way was thought of to minimize these costs by making the material available at other company plants in Budapest, Hungary or Chennai, India. With the implementation of these Hubs, the company would be able to serve the customer in less time and at a lower cost. In general lines, this project can be adapted to any PIM companies that have similar problems, leaving open to the researchers the adaptations that need to be made and, as far as possible, the introduction of computational programming that can help in the decision-making of the best hub locations.

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