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Logistical Costs: Study in a Transport Company from Santa Catarina

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Custos Logísticos: Estudo em uma Transportadora Catarinense

Resumo

Objetivo(s): Identificar os principais custos logísticos de uma empresa de transportes do Oeste de Santa Catarina a partir de diferentes segmentos operacionais. **Método(s):** Este estudo é caracterizado como descritivo, documental e qualitativo. Analisaram-se dois segmentos operacionais da empresa objeto de estudo. **Resultados:** Evidenciam que os custos variáveis têm maior representatividade nas duas operações da empresa e são compostos por: gastos com combustível, manutenção e pneus, representando mais de 80% dos custos diretos e das variáveis totais de ambas as operações analisadas. Com relação aos demais custos envolvidos, representam mais de 60% dos custos diretos. Somente o combustível representa 55% do custo total do segmento X e 54% do segmento Y. Por se tratar de transportadora, todos os gastos variáveis têm relação com o quilômetro rodado no período analisado. Já com relação aos custos fixos (diretos e indiretos), tem-se como principal gasto desse grupo a mão de obra direta e indireta, assim como os respectivos encargos.

Palavras-chave: Custos. Custos logísticos. Transportadora. Contabilidade de custos.

Logistical Costs: Study in a Transport Company from Santa Catarina

Abstract

Objective(s): Identify the main logistical costs of a transport company in the west of Santa Catarina, from different operating segments. **Method(s):** This is a descriptive, documental, and qualitative study. Two operating segments of the company under study were analyzed. **Results:** Variable costs are more representative in the two operations of the company and are composed of: expenses with fuel, maintenance, and tires, representing more than 80% of direct costs and total variables of both operations analyzed and in relation to other costs involved, represent more than 60%. Fuel alone represents 55% of the total cost of the X segment and 54% of the Y segment. As a transport company, all variable expenses are related to the kilometer traveled in the analyzed period. Regarding fixed costs (direct and indirect), the main expense of this group is direct and indirect labor and their respective charges.

Keywords: Costs. Logistic costs. Shipping company. Cost accounting.

Costos Logísticos: Estudio en una Empresa de Transporte Catarinense

Resumen

Objetivo(s): Identificar los principales costos logísticos de una empresa de transporte en el oeste de Santa Catarina, a partir de diferentes segmentos operativos. **Método(s):** El estudio se caracteriza por ser descriptivo, documental y cualitativo. Se analizaron dos segmentos operativos de la empresa objeto de estudio. **Resultados:** muestran que los costos variables son más representativos en las dos operaciones de la empresa y están compuestos por: gastos con combustible, mantenimiento y llantas, representando más del 80% de los costos directos y variables totales de ambas operaciones analizadas y en relación a otros costos involucrados, representan más del 60%. El combustible por sí solo representa el 55% del costo total del segmento X y el 54% del segmento Y. Al ser un transportista, todos los gastos variables están relacionados con el kilómetro recorrido en el período analizado. En cuanto a los costos fijos (directos e indirectos), el principal gasto de este grupo es la mano de obra directa e indirecta y sus respectivos cargos.

Palabras llave: Costos. Costos logísticos. Compañía de envíos. Contabilidad de costes.

1 Introduction

Due to the contemporary economic scenario, constant market movements have occurred, which has required companies to align their activities to remain sustainable (Vargas et al., 2016). For the authors, business sustainability depends on the efficiency and effectiveness of processes based on cost reduction and effectiveness. In this same context, they state that socioeconomic events, such as economic growth and the construction of the first highways, developed logistics in Brazil. For Vargas et al. (2016), logistics has evolved over decades and is no longer focused solely on transportation, transforming into a new area called business logistics.

In the organizations' value chain, several activities generate costs and need to be managed, aiming at competitive advantage (Souza et al., 2015). Among the activities, the authors highlight logistics and mention that due to the fierce competition among companies and the expansion of the business environment, organizations sought to develop strategies that provide a sustainable competitive advantage, including costs as an essential factor. Furthermore, for Vargas et al. (2016), logistics has also been recognized as an activity relevant to business success, and an element of its assessment is precisely cost management.

Therefore, knowledge of costs, whatever the economic activity, tends to provide competitive advantages (Martins et al., 2005). In this sense, they add that cost management becomes specifically an opportunity to support strategic decision-making with the help of accurate information, aiming to maximize results. They also emphasize that improving the transport sector can improve the country's economic efficiency by reducing logistics costs.

Undoubtedly, managing logistics is extremely relevant for companies. However, what can be seen in management practice is that decision-makers determine these costs based on experience, adding undue costs to this activity due to a lack of appropriate information, which affects the financial result (Alves et al., 2013). In this sense, Holanda, Silva, Lavor, and Sousa (2020) add that, in Brazil, companies seek to reduce their costs to increase their profit margin on revenue. Furthermore, reducing logistics costs will promote entrepreneurship and the expansion of local businesses (Bharadwaj, 2020).

According to Luz, Wobeto, and Silva (2018), the cost must be included in the final price of the product, in addition to the expected profit margin, such as costs of movement, storage, transportation, packaging, inventory maintenance, technology information, and taxes. This increasingly competitive environment requires managers to make decisions to improve results. Such decisions are influenced by internal and external factors, for example, logistics costs, which can be significant in the final composition of the price of the product or service.

Therefore, the challenge for managers is understanding these costs and acting to increase competitiveness, taking advantage of opportunities, and increasing the company's performance. This increases the importance of using management controls that allow the measurement of results segmented into routes and customers, among others (Silva et al., 2019). Gomes, Santos, Barbosa, and Carvalho (2019) emphasize that road freight transport is predominant in Brazil, according to data from the Brazilian Institute of Geography and Statistics (IBGE), and its movement can represent up to two-thirds of logistics costs.

Companies with efficient logistics activities from an economic point of view have greater competitiveness and stability in the market. However, this requires analysis and reduction of costs on transport routes (Gomes et al., 2019). Transportation is among the logistical activities that consume the most financial resources (Freitas et al., 2012). Due to the increasing supply of products and services by organizations, it is becoming increasingly complex to understand and evaluate the various components of logistics costs, with the complexity of evaluating total logistics costs being high due to the diversity of related costs, which becomes even more challenging for organizations (Souza et al., 2014).

Some difficulties in costing logistics activities refer to the high proportion of indirect costs and the high segmentation of products and services (Martins et al., 2005). There is a huge need for accurate cost information about such activities to reduce such difficulties and alleviate challenges, i.e., logistics cost efficiency is necessary (Everaert et al., 2008). This primarily occurs because logistics costs represent a significant and relevant portion of companies' costs, and their share of companies' revenue tends to exceed at least 10% (Engblom et al., 2012). Therefore, reducing costs continues to represent one of the biggest challenges for logistics professionals (Freitas et al., 2012).

From a specific perspective on the food industry, Souza, Schnorr, and Ferreira (2013) emphasize that logistics focuses on maintaining the quality of products, from packaging to storage and distribution, further increasing the importance of the activity. Consequently, they advocate that knowledge about logistics costs has become increasingly relevant for the competitiveness of companies, and the main challenge lies in implementing management practices that enable the measurement of logistics costs.

In the organizational context, transport is associated with companies' main logistical cost item. The primary mode of transport in Brazil is road, i.e., it generates representative costs for those who need to deliver their products in different regions and those who purchase the products or inputs (Kruger et al., 2019). However, the authors point out that costs vary per kilometer driven, considering the value of fuel, maintenance and depreciation, labor, and tolls, among other costs that alter the result per kilometer driven, making their identification and management essential without management information on logistics costs.

Souza et al. (2015) understand that strategic cost management must be dynamic to meet rapid changes in the environment, as well as the growing diversity of products and manufacturing processes, and, in this sense, there is also a need to identify, use, and manage logistical costs. For Stępień, Łęgowik-Świącik, Skibińska, and Turek (2016), the problem that companies have in identifying and measuring logistics costs impacts management processes and business efficiency and therefore deserves more and more attention.

Within this context, this study aims to answer the following research problem: What are the main logistical costs of a transport company in the west of Santa Catarina? The study aims to identify the primary logistics costs of a transport company in the West of Santa Catarina from different operating segments to answer the research problem.

Analyzing transport companies is justified, as logistics is part of everyday business life, from production and storage to transportation, and is constantly growing and seeking better efficiency in operations, standing out as the activity responsible for the highest product costs in commerce (Holanda et al., 2020). Furthermore, logistics costs impact international trade and a nation's economic growth (Cho, 2014).

To demonstrate the importance and growth of transport activity, we can observe its representation in the publication carried out in the first quarter of 2022, referring to 2021 by the National Transport Confederation (CNT), which highlights that transport grew by 11.4 %. The aggregate Gross Domestic Product (GDP) grew by 4.6% compared to 2020. Thomas, Correa, Luft, Machado, Fenner, Oliveira, and Fernandes (2019) highlight that among the logistics modes used by companies, road transport is one of the most used in Brazil, which makes it even more relevant to know the costs and expenses of transporting this mode, primarily because most companies still depend heavily on road transport (Dong et al., 2018).

This study is also justified due to the high competition in the search for freight and fluctuations in the cost of transportation. According to Kruger et al. (2019), determining freight depends on cost analysis and other attributes, such as geographic location, return load, and load value. These fluctuations can be observed in fuel, the primary input for transport operations. In this sense, the National Transport Confederation (CNT) published in March 2022 the increases for the year 2021, which totaled 50% compared to the final value of the previous year (CNT,

2022). Another cost-generating concern is the lack of infrastructure on highways, as 61.8% of the Brazilian road network is classified as regular, poor, or very poor (CNT, 2021; CNT, 2022).

Therefore, considering this panorama, it is understood that the measurement and analysis of logistics costs are increasingly becoming a competitive differentiator for organizations (Kruger et al., 2019). To this end, managing the logistics chain and identifying its costs can provide information for managers to make decisions, thus enabling competitive advantage (Alves et al., 2013). Identifying and measuring logistics costs accurately can contribute to subsidizing and improving information and, consequently, decisions, providing better organizational results (Vargas et al., 2016), mainly because, according to Kučera (2018), logistics costs are a critical indicator to measure efficiency.

The contribution to the theory comes from the application of cost concepts, especially logistics in the transport sector, considering that the costs of such activity, especially road, are one of the most prominent on the national scene and impact the results of companies. In this sense, this research could contribute to putting the concepts into practice, serve as a guide for other studies, and highlight the possibility of using different costing methods for measurement.

The practical contribution refers to identifying the primary logistics costs of a company in the transport sector, aiming to help the company and others in the same sector to pay attention to related costs, often hidden in traditional reports, and, thus, carry out the calculation and management so that better decisions are made promptly, in addition to rethinking the recently used practices.

In addition to contributing to the company analyzed, the results and their analysis may contribute to other companies in the same sector and the region's economy, optimizing costs and increasing the competitiveness of organizations, which is reflected in society in general. Based on the above, it is understood that the control and management of logistics costs are becoming increasingly important, especially regarding road transport costs, which stand out on the national scene.

2 Literature Review

This section sought to write about logistics costs and then presented related studies.

2.1 Logistics Costs

Logistics is the product when organizing the flow of information, materials, and people (Thomas et al., 2019). For the authors, companies must develop appropriate logistics strategies to succeed and not lose competitiveness in the market, as their customers and the commercial scenario are constantly changing. To this end, the purpose of logistics can be expressed in terms of having the best-perceived value for the customer (Souza et al., 2014).

For Faria and Costa (2005), logistics activity is present in supplying factories with raw materials and storing and transporting the finished product to the final consumer. Its management aims to mitigate final production costs and increase the level of delivery to the consumer. In this sense, Kruger et al. (2019) advocate that modern logistics becomes increasingly relevant in marketing, being considered a strategic action to meet customer demands. Furthermore, logistics aims to achieve the best perceived value for customers, maximizing the difference between value and actual costs (Kruger et al., 2019).

Costs have become relevant for decision-making, as knowing how much is spent to produce or provide a service, it is possible to define the sales price and thus measure its result (Martins & Conceição, 2021). They correspond to expenses with goods or services consumed in producing other goods or services, i.e., all expenses incurred in the production or service

provision process (Lyrio et al., 2017). For Faria and Costa (2005), costs are essential elements, as they are related to the sacrifices of resources that occur in the production process.

According to Santos, Silva, Barreto, and Guazzeli (2018), costs can directly influence the organization's profit, decision-making, production, and planning. Therefore, cost management in a structured and detailed way will allow companies to plan, estimate, determine, and control resources efficiently, which is essential for decision-making (Martins & Conceição, 2021). In a competitive scenario, there is a constant search for reducing costs and, at the same time, maintaining the quality of products and services. However, companies must know the subject (Luz et al., 2018).

Logistics costs are especially complex and challenging to identify concerning related processes and objects (Stępień et al., 2016). Furthermore, they can be isolated by classifying expenses by function, using appropriate criteria for dividing the company's total costs (Stępień et al., 2016). Also, according to the authors, the separation of logistics costs is significant for increasing the efficiency of business management, as the identification, measurement, and recording of logistics costs are the primary conditions for improving the management of such costs.

The benefit for companies that use a control approach in managing logistics costs is the reduction of overhead expenses, which can affect product prices and demand, meet customer needs, reduce total costs, and increase sales and profits revenue (Kučera, 2018). Given this, Stępień et al. (2016) emphasize that minimizing logistics costs and maintaining greater effectiveness leads to considering logistics costs as an instrument that generates the company's financial results.

The elements of logistical costs are diverse and vary in the authors' conception. However, many correlate somehow (Souza et al., 2014). For the authors, the following are elements of logistics costs: purchasing, storage, production, distribution, transaction, and service costs. In the same sense, Engblom et al. (2012) comment that the literature identifies a wide range of logistics cost components, including transportation, storage, inventory, and logistics administration, and is not limited to the definition and understanding of the components.

Souza et al. (2013) also mention that logistics costs can be characterized by service levels, costs of batches, packaging, inventory maintenance, order processing, transportation, and also costs of reverse logistics and production planning and control. Such costs also abound in measurement and analysis approaches (Engblom et al., 2012).

The analysis of costs related to companies' logistics becomes essential for creating a competitive advantage, enabling the control of expenses that can provide the necessary agility for the best quality of logistics processes (Andrioli et al., 2015). Most of the literature considers that minimizing logistics costs refers to the need to reduce transport costs in particular (Minken & Johansen, 2019).

This is because road transport is one of the main expenses related to cost formation (Kruger et al., 2019). They complement that the logistical costs that must be added in the formation of prices refer to maintenance, depreciation of means of transport, taxation, planning and administration, labor, fuel, toll, and insurance expenses. They also emphasize that truck maintenance costs represent up to 50% of the transporter's gross income. For Holanda et al. (2020), this is mainly due to the precarious infrastructure of transport services, increasing the price of products and making them less competitive in international trade.

According to Kruger et al. (2019), when analyzing transport costs, it is necessary to identify all direct and indirect costs related to the activity, from expenses with fuel, insurance, maintenance, depreciation, toll expenses, labor and charges, to expenses with management (planning and administrative control). Therefore, they emphasize that the complexity of cost formation requires adequate controls and constant analysis to identify alternatives to minimize

such expenses in the search for competitive advantage. However, the shipper's problem is precisely to minimize all relevant logistics costs, including transportation costs, which are related to the size of the shipment, the size of the vehicle, and the refueling point, among others (Minken & Johansen, 2019).

Given this, logistics cost management follows this discussion and the evolution of the logistics concept through new emerging techniques and issues related to the analysis of logistics costs (Vargas et al., 2016). Controllership can manage critical business processes and enable the company to build a concept of continuous improvement, aiming to reduce logistics costs (Kučera, 2018). Knowing that the sales value of a given product can be influenced by logistics costs, knowledge and management of these costs become relevant in business strategy (Nilson et al., 2020).

2.2 Related Studies

From the point of view of managing internal logistics costs, there is the critical function of controlling related costs, from order processing, transportation, storage, and stock-pilling of products (Souza et al., 2015). For the authors, logistics is also responsible for controlling the costs of distributing goods to customers in industry and retail. To this end, they emphasize that the relevance and expressiveness of the volume of resources consumed in these activities have motivated the development of several research studies on the topic. Given this, some related studies that address logistics costs in transport companies were located. They focus mainly on road transport, considering that it is the sector and activity analyzed in this study.

Freitas et al. (2012) investigated performance indicators and their contribution to managing logistics costs in a transport company. They verified that the company's logistics seek to develop mechanisms to deliver products to their destination quickly. Furthermore, they use performance indicators as a strategy to reduce logistics costs. They found that transport is a fundamental element of logistics costs for companies and that cargo movement absorbs one to two-thirds of total logistics costs and must be analyzed and managed, aiming for continuous improvement.

Thomas et al. (2019) investigated the main costs in the road transport mode that affect the final profit of a transport company in the South of Brazil. The results revealed that of the company's total transport costs, 36.42% are represented by fixed costs and 63.58% by variable costs. In the fixed cost group, the expenses that stood out the most were *pro-labore*, insurance, and depreciation. Variable costs represent more than half of the total, with the most representative expense being fuel, followed by maintenance, tire costs, washing, and lubrication.

The article prepared by Gomes et al. (2019) has the general objective of demonstrating the use of routing, modeling, and computer simulation, starting from a case study in a civil construction materials distributor located in the center-south region of Belo Horizonte and aiming to reduce logistical transport costs. The final results demonstrated that the route adopted by the company for the southeast region was not viable and economically satisfactory. They obtained a new proposition to reduce costs by approximately 48.1% and 46.9% of the distance in transport logistics through the applied operating research and linear programming method.

The study by Silva et al. (2019) focuses on the representation of costs on operations in a company in cargo transport and its influence on organizational processes. They identified the company's unit, total revenues and costs, and the representativeness of each truck for the enterprise. They concluded that the profitability of the transport segment could be obtained through the total and unit contribution margin for trucks. Regarding the balance point of transport operations, they identified the leveling between revenues, costs, and expenses, individually or across the fleet. Finally, concerning recognizing the safety margin, they

determined the amounts necessary for the result to be null and the ranges for obtaining profit/loss.

The research by Kruger et al. (2019) aimed to compare logistical costs between the main transport routes of a cooperative in Santa Catarina. The results show that the main costs of road transport are related to fuel, maintenance, and depreciation costs, with values changing per kilometer driven according to the regions of transported cargo. Furthermore, from the results obtained, it is possible to identify options between the most profitable routes, considering that the costs identified per kilometer driven demonstrate significant differences in the logistical costs of the different routes due to the cost of tolls and fuel.

The work of Nilson et al. (2020) intended to map total logistics costs and calculate a logistics cost indicator referring to expenses incurred for using port services, analyzing their impact in the context of the total logistics cost. The results demonstrated that the participation of port costs in forming total logistics costs varies substantially from one company to another. Port costs represent more than 30% of total logistics costs in some companies. Furthermore, they demonstrated that factors such as the volume of exports and the place of destination of the goods do not correlate with the cost incurred.

Localized studies showed that logistics costs have gained notoriety and deserve to be investigated, whether to help companies or society in general, which feels the consequences of high related costs, especially concerning transport activities. Therefore, identifying, analyzing, and managing is essential for improvement and for the company to create competitive advantages to remain in the market.

3 Methodological Procedures

Descriptive, documentary, and qualitative research was carried out to identify the primary logistics costs of a transport company in the West of Santa Catarina from different operating segments.

The study environment refers to a large company located in the west of the State of Santa Catarina, which operates in the cargo transportation sector, operates in practically all Brazilian states, and specializes in refrigerated cargo transportation. The company was chosen due to accessibility. Furthermore, it should be noted that the company was chosen because it is completing the process of implementing a transport management system, which aims to improve data control and the possibility of analyzing operating indicators.

The company analyzed has 25 years of history, with its first unit established in the west of Santa Catarina. Today, it stands out as one of the fastest-growing refrigerated transport companies in the country, with branches spread throughout Brazil. It has a fleet of 780 vehicles, of which 700 are refrigerated and 80 for general cargo. It employs an average of 1,200 direct employees. It is involved in the logistics chain of the leading industries in Brazil, for example, BRF, Cooperativa Central Aurora Alimentos, Unilever, and JBS (Seara Alimentos), providing services in primary and secondary operations, that is, collection of raw materials and delivery to the final consumer. For ethical reasons, the name of the company will not be disclosed.

The information collected refers to management reports used by the company. In the company's system, expenses are already recorded separately by cost center and by vehicle, which was requested by those responsible for the company's logistics and accounting areas, who passed on the information to calculate the costs. The data refers to January 2022. In addition, it was collected in February and analyzed from March to May of the same year.

With the data in hand, it was initially divided and classified into fixed and variable, direct and indirect. Afterward, the data was tabulated in electronic spreadsheets, and the data was grouped to present them in tables, calculating the cost per vehicle and km driven. It should

be noted that the values presented in the survey were multiplied by an undisclosed index to avoid disclosing the company's actual data.

4 Analysis of Results

This section initially presents the company's operating segments used as objects of study, identification, and classification of costs between direct, indirect, fixed, and variable. Subsequent costs are collected and presented in separate tables according to the initial classification and operating segments.

4.1 Operating Segments

The operating segments analyzed in the study are characterized by primary and secondary fixed contracts, as shown in Table 1 below. Information was requested from the managers responsible for the region to seek knowledge and obtain more information regarding the characteristics of the operations.

Table 1
Operating Segments

Operating Segment	Region	Characteristic	Qty. Vehicles
Operation X	South	Fixed primary	2
Operation Y	Northeast	Fixed secondary	3

Source: Prepared by the authors (2022).

Contracts with a fixed primary characteristic mean that the vehicles are dedicated to a single customer, available to transfer raw materials between industrial units. Secondary operations have as their main characteristic the delivery of finished products for resale to the final consumer.

4.2 Cost Identification

After choosing the operating segments used as the research object, the costs involved in the company's transport operations were surveyed, classifying them as direct, indirect, fixed, and variable, as shown in Table 2.

Table 2
Direct and Indirect Costs of Transport Operation

Direct Costs	
Variable	**Fixed**
Fuel	Labor
Maintenance	Labor Charges
Tire	Licensing
	Fleet Insurance
	Tracker Monthly Fee
	Depreciation
Indirect Costs	
Fixed	
Operating Labor	
Operating Labor Charges	
Operation Room Rent	

Source: Prepared by the authors (2022).

The costs identified in the analyzed carrier are direct and indirect, fixed and variable. Initially, direct and variable costs refer to fuel, maintenance, and tires, also mentioned by

Kruger et al. (2019) and Thomas et al. (2019). Concerning direct and fixed costs, there are labor and its charges, licensing, insurance, depreciation, and tracking (monthly fees), some of these already mentioned by Kruger et al. (2019) and Thomas et al. (2019).

The values of each group shown in Table 2 were measured using the company's TMS management tool, a software that, according to Banzato (2005), works for transport administration, as it allows the user to visualize and control the logistics operation. Its main benefits are ensuring order traceability and productivity throughout the distribution process. It is also a tool that aims to add value to a company's transport service and reduce the cost of the logistics area. Table 3 below shows the company's logistics costs, depending on its operations.

Table 3
Logistics Costs

		Costs	Segment X	Segment Y
Direct	Variable	Fuel	18,529.38	23,460.69
		Maintenance	2,371.33	2,556.29
		Tire	1,334.08	2,320.47
	Fixed	Labor	5,460.42	8,164.59
		Labor Charges	949.53	1,377.34
		Licensing	424.40	568.48
		Fleet Insurance	277.14	415.71
		Tracker Monthly Fee	498.00	747.00
		Depreciation	0.00	0,00
Indirect	Fixed	Operating Labor	3,150.76	3,033.45
		Operating Labor Charges	236.31	227.51
		Operation Room Rent	415.00	0.00
		Total	**33,646.35**	**42,871.53**

Source: Prepared by the authors (2022).

According to Table 3, it is possible to view the total costs of each segment analyzed (X and Y) and then carry out the apportionment. Therefore, it is noted that the most relevant variable (direct) cost is fuel costs, which represent approximately 83% of the total variable cost of operation X and 82% for operation Y. Concerning the set of variable direct costs to other fixed direct and fixed indirect costs, these represent around 65% for each segment analyzed. The most significant fixed cost is labor costs, which do not vary due to production per kilometer driven in the period. Operation Y has a higher total due to the number of employees.

The results support the findings of Thomas et al. (2019), as they identified that 36.42% are fixed costs and 63.58% are variable costs. In the fixed cost group, the expenses that stood out the most are related to *pro-labore*, which, in the case of this research, is represented by labor and its respective charges. However, they are in line concerning insurance and depreciation, which were not considerable. They are also consistent with the research by Thomas et al. (2019) in terms of the highest variable costs, which represent more than half of the total, being represented by fuel expenses, followed by maintenance and tires.

4.3 Direct Costs

4.3.1 Variable Costs

This section will present the calculations referring to the direct and variable costs of segments X and Y of the analyzed carrier, referring to January 2022. As previously stated, variable fuel, maintenance, and tire costs exist.

Initially, concerning fuel, the average cost of diesel, kilometer per hour (km/h) driven, and vehicle consumption in January 2022 were identified. The cost calculation must be carried out using two methods due to the use of refrigerated vehicles. For tractor vehicles, the km

driven was divided by the vehicle's consumption in kilometers per liter (km/L) and then multiplied by the cost of diesel. As for refrigeration equipment, the hours worked were multiplied by consumption (h/L) and, finally, by the cost of diesel. Table 4 shows the values of operating segments X and Y.

Table 4
Fuel Cost

Fuel	**Operating Segment X**		**Operating Segment Y**		
Tractor	**XXX0001**	**XXX0002**	**YYY0001**	**YYY0002**	**YYY0003**
Liter Value	4.22	4.22	4.34	4.34	4.34
km driven	4,000	3,700	4,600	4,100	3,700
Average km/L Vehicle	1.86	2.04	2.71	2.63	2.44
Monthly Value	**9,085.38**	**7,662.45**	**7,368.32**	**6,767.18**	**6,582.51**
Refrigeration Equipment	**XXX0001**	**XXX0002**	**YYY0001**	**YYY0002**	**YYY0003**
Liter Value	4.22	4.22	4.22	4.22	4.22
Average hours Worked	60	65	40	65	65
Average h/L Equipment	3.80	2.98	4.01	3.69	3.83
Total Monthly Cost	**963.23**	**818.32**	**677,64**	**1,013.29**	**1,051.74**
Total Monthly Fuel Cost	**10,048.61**	**8,480.77**	**8,045.96**	**7,780.48**	**7,634.25**
	18,529.38			**23,460.69**	

Source: Prepared by the authors (2022).

For segment X, the total fuel cost for January 2022 was R$ 18,529.38 (the sum of both vehicles). Operating segment Y totaled R$ 23,460.69 (sum of three vehicles). This represents an average of R$ 9,264.69 per vehicle for segment X and R$ 7,820.23 for segment Y, i.e., operation X had a higher cost during the study period.

For maintenance, the total cost was initially measured, from purchase until the date of December 31, 2021, for vehicles, tractor, trailer, and refrigeration equipment, dividing this value by the total kilometer driven of the vehicles and total hours worked on the equipment, identifying thus the cost per kilometer driven and hour worked for each vehicle and equipment, this value is then multiplied by the quantity driven and worked in the period.

The cost value of each vehicle and equipment was obtained, as shown in Table 5. This method was used because maintenance must be accounted for as the vehicle runs and the refrigeration equipment works since there will be months in which there will be no disbursements with maintenance.

Table 5
Maintenance Cost

Maintenance	**Segment X**		**Segment Y**		
Tractor	**XXX0001**	**XXX0002**	**YYY0001**	**YYY0002**	**YYY0003**
Total Maintenance Cost	89,021.33	79,058.97	79,987.42	13,762.99	96,933.31
Total km Driven	376,060	389,543	376,181	158,115	502,172
Cost km Driven	0.237	0.203	0.213	0.087	0.193
Monthly km Driven	4,000	3,700	4,600	4,100	3,700
Monthly Value	**946.88**	**750.93**	**978.10**	**356.88**	**714.20**
Trailer	**XXX0001**	**XXX0002**	**YYY0001**	**YYY0002**	**YYY0003**
Total Maintenance Cost	28,178.87	21,331.85	12,392.11	1,274.38	8,996.42
Total km Driven	376,060	389,543	376,181	158,115	502,172
Cost km Driven	0.075	0.055	0.033	0.008	0.018
Monthly km Driven	4,000	3,700	4,600	4,100	3,700
Monthly Value	**299.73**	**202.62**	**151.53**	**33.05**	**66.29**
Equipment	**XXX0001**	**XXX0002**	**YYY0001**	**YYY0002**	**YYY0003**
Total Maintenance Cost	3,921.97	17,983.61	6,168.56	14,326.75	21,295.97
Total h Worked	3,425	11,408	7,945	7,925	12,855
Cost per h Worked	1.145	1.576	0.776	1.808	1.657
Monthly h Worked	60	65	40	65	65
Total Monthly Cost	**68.71**	**102.47**	**31.06**	**117.51**	**107.68**
Total Monthly Maintenance Cost	**1,315.32**	**1,056.01**	**1,160.69**	**507.43**	**888.17**
	2,371.33			**2,556.29**	

Source: Prepared by the authors (2022).

Based on the results in Table 5, it is possible to verify that operation X had a total maintenance cost of R$ 2,371.33, while operation Y had a total of R$ 2,556.29. Therefore, operation Y presents a higher cost, which can be explained by the number of vehicles in the operation. When analyzing an average per vehicle, operation X represented a higher cost. In conversation with the maintenance manager, the justification is that the maintenance costs of trailers are higher for operation X, as the year of manufacture is lower than operation Y, thus generating a higher cost. It is understood that this can be explained by the quality of Brazilian highways, as according to the CNT (2021; 2022), 61.8% of the highway network is classified as regular, bad, or very poor, causing losses and damage to trucks, increasing thus maintenance costs.

Concerning the cost of tires, initially, it should be noted that the segments used in this research have 6x2 tractor-type vehicles and semi-trailers with three axles, i.e., 18 shallow-tread tires and four deep-tread tires are required. The company works with the purchase of new tires and retreading. Initially, the average cost of purchasing and retreading in the region of the operating segments was identified. An analysis was then carried out with the person responsible for the area to identify the average useful life of the tires in kilometers. Thus, we could identify the average cost per kilometer driven with these two values. After identifying the cost per kilometer driven, the value was multiplied by the number of tires and kilometers driven on the vehicle during the study period, as seen in Table 6.

Table 6
Tire Cost

Tire	**Segment X**		**Segment Y**		
Shallow-tread Tire	**XXX0001**	**XXX0002**	**YYY0001**	**YYY0002**	**YYY0003**
Purchase + Retreading Cost	2,238.51	2,238.51	2,429.41	2,429.41	2,429.41
Lifespan	320,000	320,000	320,000	320,000	320,000
Quantity of Tires	18	18	18	18	18
Cost km Driven	0.126	0.126	0.137	0.137	0.137
km Driven	4000	3700	4600	4100	3700
Total Shallow-tread Tire Value	**503.66**	**465.89**	**628.61**	**560.28**	**505.62**
Deep-tread Tire	**XXX0001**	**XXX0002**	**YYY0001**	**YYY0002**	**YYY0003**
Purchase + Retreading Cost	2,485.44	2,485.44	2,650.17	2,650.17	2,650.17
Lifespan	210,000	210,000	210,000	210,000	210,000
Quantity of Tires	4	4	4	4	4
Cost km Driven	0.047	0.047	0.050	0.050	0.050
km Driven	4000	3700	4600	4100	3700
Total Deep-tread Tire Value	**189.37**	**175.16**	**232.21**	**206.97**	**186.77**
Total Monthly Tire Cost	**693.03**	**641.05**	**860.82**	**767.25**	**692.40**
	1,334.08			**2,320.47**	

Source: Prepared by the authors (2022).

It can be seen in Table 6 that tire costs are higher for operation Y. Therefore, what justifies this is not only the number of vehicles in operation but the fact that the average cost of purchasing and retreading in the region is higher, thus increasing costs per kilometer driven.

4.3.2 Fixed Costs

Regarding fixed direct costs, which refer to labor, labor charges, licensing, fleet insurance, monthly tracking fee, and depreciation, it is initially assumed that to measure labor costs, a survey was carried out of all employee expenses in each operation. The total comprises base salary, food vouchers, 13th salary provisions, vacation provisions, and Service Time Guarantee Fund (FGTS) of 8% on earnings (salary/vacation/13th salary), as shown in Table 7.

Table 7
Labor Cost

Labor	Segment X	Segment Y
Salary	1,997.23	1,833.32
FGTS	159.78	146.67
Food Voucher	159.78	362.05
13th Salary Provision	166.44	152.78
FGTS 13th Salary Provision	13.31	12.22
Vacation Provision	166.44	152.78
1/3 Vacation Provision	49.93	45.83
FGTS Vacation Provision	17.31	15.89
Total Employee Value	**2,730.21**	**2,721.53**
Number of Employees	**2**	**3**
Total Segment Value	**5,460.42**	**8,164.59**

Source: Prepared by the authors (2022).

The total monthly cost between the two segments is higher for operation Y, totaling R$ 8,164.59. However, if we analyze the unit cost per vehicle/employee, operation X has a greater representation, even if there is little difference in value, i.e., just R$ 8.68. The difference in the final amount is because segment X has only two employees, while segment Y has three.

Concerning labor costs, there are employer charges of 1.7%, contribution to third parties of 5.8%, and payroll exemption of 1.5% concerning gross revenue, as the company contributes through Social Security Contribution on Gross Revenue (CPRB). Table 8 presents the total costs with charges.

Table 8
Labor Charges

Labor Charges	Operation X	Operation Y
Contribution to Third Parties	316.70	473.55
Employer Charges	92.83	138.80
Exemption	540.00	765.00
Total Value of Charges	**949.53**	**1,377.34**

Source: Prepared by the authors (2022).

Given what is shown in Table 8, it is noted that the costs of charges for operation Y are higher since the number of employees and, consequently, the calculation base is larger. Regarding licensing, all expenses for tractor and trailer vehicles were divided by 12 months, making it possible to find the monthly cost per vehicle, as shown in Table 9.

Table 9
Licensing Cost

Licensing	Segment X		Segment Y		
Tractor	**XXX0001**	**XXX0002**	**YYY0001**	**YYY0002**	**YYY0003**
IPVA	2,392.06	2,392.06	2,392.06	2,123.97	1,693.2
Licensing	77.19	77.19	77.19	176.79	102.09
Trailer	**XXX0001**	**XXX0002**	**YYY0001**	**YYY0002**	**YYY0003**
Licensing	77.19	77.19	77.19	77.19	102.09
Total Annual	**2,546.44**	**2,546.44**	**2,546.44**	**2,377.95**	**1,897.38**
Total Monthly	**212.20**	**212.20**	**212.20**	**198.16**	**158.12**

Source: Prepared by the authors (2022).

The licensing costs for operation X were R$ 424.40, while for operation Y, the total was R$ 568.48. We can see that the cost is the same for three vehicles, XXX001, XXX002, and YYY0001, because the vehicles have the same brand, model, and year of manufacture and were registered in the same federative unit since the Motor Vehicle Property Tax (IPVA) is calculated based on the value of the vehicle. Furthermore, licensing has a fixed fee defined by the registration state, which is why vehicles have the same cost.

Table 10 shows third-party vehicle insurance, only covering damage to third-party goods, with an annual closed contract and a fixed value per vehicle regardless of model and year. Costs were identified and distributed monthly.

Table 10
Vehicle Insurance Cost

Insurance	Operation X	Operation Y
Annual Cost	1,662.85	1,662.85
1/12 Monthly Cost	138.57	138.57
Number of Vehicles	2	3
Total Operation Cost	**277.14**	**415.71**

Source: Prepared by the authors (2022).

Given what is shown in Table 8, it is possible to note that the unit cost per vehicle is the same for both operations. The total is more representative of operation Y as it has more vehicles. Table 11 below shows the tracker's monthly fee per operation. The amount is fixed monthly per tractor vehicle, i.e., trailers and equipment do not have this cost.

Table 11
Tracker Monthly Fee Cost

Tracker Monthly Fee	Operation X	Operation Y
Monthly Cost	249.00	249.00
Number of Vehicles	2	3
Total Operation Cost	**498.00**	**747.00**

Source: Prepared by the authors (2022).

The data in Table 9 demonstrates that operation X presents a less representative total cost with the tracker, as it has fewer vehicles.

Finally, regarding depreciation, it is noteworthy that during the research period and concerning the vehicles analyzed, the entity had no depreciation costs in the operating segments, as it uses normative instruction SRF no. 162 of December 31, 1998 (Receita Federal, 1998), in which tractors are depreciated in four years and trailers in five. Therefore, all vehicles in the operating segments have already been depreciated 100%, as the tractors are from 2014 and 2012, respectively. The trailers are from the years 2010, 2012, and 2014.

4.4 Indirect/Fixed Costs

The transport company's indirect and fixed costs include operating labor, indirect labor charges, and operation room rent. Initially, concerning the indirect operational workforce of operating segments X and Y used in the research, there are expenses with payroll and provisions, as shown in Table 12. The two operations have a single employee for control and operating activities.

Table 12
Indirect Labor Cost

Indirect Labor	**Operation X**	**Operation Y**
Salary	2,324.00	2,075.68
FGTS	185.92	166.05
Food Voucher	159.78	362.05
13th Salary Provision	193.67	172.97
FGTS 13th Salary Provision	15.49	13.84
Vacation Provision	193.67	172.97
1/3 Vacation Provision	58.10	51.89
FGTS Vacation Provision	20.14	17.99
Total Indirect Labor Cost	**3,150.76**	**3,033.45**
Number of Vehicles	**2**	**3**
Costs per Vehicle	**1,575.38**	**1,011.15**

Source: Prepared by the authors (2022).

From Table 12, it can be seen that operation X and direct labor costs are higher than operation Y. When distributing this indirect cost between the operations vehicles, R$ 1,575.38 is applied to each vehicle for operation X and R$ 1,011.15 for operation Y. Therefore, it is observed that as it is a fixed cost with a larger number of vehicles in operation (3), the cost that each vehicle receives in distribution is lower. Below, Table 13 presents the costs of indirect labor charges. They are made up of contributions for third parties and employer charges. Payroll exemption was not considered, as it is already included in direct labor charges. Furthermore, the same value would be doubled as it is calculated on revenue when also considering this group.

Table 13
Cost of Indirect Labor Charges

Labor Charges	**Operation X**	**Operation Y**
Contribution to Third Parties	182.74	175.94
Employer Charges	53.56	51.57
Total Value of Charges	**236.31**	**227.51**
Number of Vehicles	**2**	**3**
Costs per Vehicle	**118.15**	**75.84**

Source: Prepared by the authors (2022).

When distributing the cost among the vehicles in operation X, the value is R$ 118.15 for each vehicle and R$ 75.84 for the vehicles in operation Y. It can be observed that operation Y has a less significant total per vehicle, which can be justified again by the number of vehicles to distribute the cost, and, as it is a fixed cost, it does not vary with the production of vehicles.

Finally, regarding the rental of the operating room, it should be noted that operation Y has no rental costs because it uses the room in the client's unit at no cost to the company. Table 14 presents the operating rental costs for operation X.

Table 14
Operation Room Rental Cost

Operation Room Rent	Operation X	Operation Y
Monthly Cost	**415.00**	**0**
Number of Vehicles	2	3
Cost per Vehicle	207.50	0

Source: Prepared by the authors (2022).

From the data in Table 14, it can be seen that if we apply the monthly rental cost of operation X to the vehicles, i.e., R$ 412.00 for both vehicles, there is a total cost of R$ 207.50 per vehicle in this operating segment. As this is a fixed cost, there will be no variation in the total cost if new vehicles are added to the operation. There would only be variation in the cost applied per vehicle, with each vehicle receiving a lower cost in forming its result.

5 Final Considerations

The research had the general objective of identifying the logistics costs of a transport company in the West of Santa Catarina based on two operating segments characterized by different numbers of vehicles in each. The research results reveal that variable costs are of greater relevance in the two operations used as the object of the study, with these costs having reference to the kilometer driven in the period, i.e., the greater the effort per kilometer traveled by vehicles, the greater the fuel, maintenance, and tire costs.

The results are in line with the research by Kruger et al. (2019) and Thomas et al. (2019), who also highlighted fuel and maintenance expenses as the main costs of road transport, differing only from depreciation expenses in the case of the research by Kruger et al. (2019), as the segments used in the research already had their vehicles 100% depreciated, with no costs incurred during the research period. The cost of tires was also not as representative in this research, but it was also evidenced in the research by Thomas et al. (2019), supporting the findings.

Regarding fixed costs, these do not affect the number of kilometers traveled by vehicles. Even without any activity, they total R$ 11,411.56 for operation X and R$ 14,534.08 for operation Y. Their sum represents around 36% of each of the operations analyzed, which is also consistent with the research by Thomas et al. (2019), who identified fixed costs of 36.42%. In the fixed cost group, the expenses that stood out most in this study were labor and its respective charges, which corroborates the results of Thomas et al. (2019) when referring to *pro-labore* since, in this research, the authors analyzed a small company.

Given the above, the logistics costs of the analyzed carrier refer to fuel, maintenance, tires, labor and direct charges, licensing, fleet insurance, monthly tracking fee, depreciation, labor and indirect charges, and operating rent. In addition, there are more direct costs than indirect ones. Furthermore, the most representative costs were fuel expenses, which represent 55% of the segment's total cost, totaling R$5,460.42 for the segment of operations, one for operation X and one for Y.

Above all, this study contributes to the theory by exploring the concepts of costs, especially logistics, and referring to the road mode, identifying costs related to vehicles, and

separating them into different segments. This allows one to broaden the perspective through the detail in the analysis, which can be used as a basis for other research using different methodologies. This article advances concerning those identified by separating costs by operating segments, making the result more explicit and dynamic. Furthermore, it details all individual and total costs and values concerning each vehicle and each segment analyzed, as, according to Stępień et al. (2016), logistics costs are complex and challenging to identify.

In terms of practical contribution, this research helps the company analyzed and other companies in the same sector, demonstrating the need and relevance of identifying costs to carry out its management and make critical decisions to improve the company and create competitive advantage, as recommended by Andrioli et al. (2015) and Kučera (2018). Segregating costs into direct, indirect, fixed, and variable allows the analyzed company to identify the cost per kilometer driven for the two operating segments, bringing the amount paid closer to the amount negotiated with its customers for operations with the same work model. Likewise, conducting a cost survey of other operations can identify the most profitable for the company.

Social contribution refers to the impact of research on society, whether concerning cost reduction in companies that use this type of information and put it into practice, aiming to have greater profits and, consequently, can better remunerate their employees. Furthermore, by managing and seeking to reduce logistics costs, the costs of products sold to customers, who represent society, tend to be lower. This can be explained by Kučera (2018), who emphasizes that the benefits can be felt through the prices of the products that affect customers, as the sales value is influenced by the logistical costs involved, as recommended by Nilson et al. (2020).

As the study's main limitation, it is possible to mention the identification of maintenance costs, as the company is implementing a new management system. Therefore, it was necessary to use two databases to find this cost. It should be noted that the results cannot be generalized since the research refers to one company and the transport sector. To this end, it is suggested that future studies be conducted analyzing all operating segments of a transport company, with a more extended period for analysis, also evaluating revenue information to identify the operating results of the segments, presenting other indicators such as contribution margin, break-even point, safety margin, among others.

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