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Estimation of costs in the textile industry: A case study

Estimativas de custos na indústria têxtil: Um estudo de caso

Estimación de costos en la industria textil: Un caso de estudio

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Abstract
This topic is approached through a case study of a textile industry located in São Paulo. The textile melioration process was selected to have its capacity analyzed. The choice of these stages of the production chain is based on the fact that they are the main production processes within the company that involve a large flow of raw materials and labor. The results of this research serve to review and analyze the total manufacturing costs of items produced in the company. And also for future economic studies of the production chain, creating an academic reference on the subject.
Keywords: Textile melioration; Unity cost; Labor.

Resumo
Este tema é abordado através de um estudo de caso de uma indústria do ramo têxtil, localizada em são paulo. Foi selecionado o processo de beneficiamento têxtil para ter sua capacidade analisada. A escolha destas etapas da cadeia produtiva baseia-se no fato de serem os principais processo de produção dentro da empresa que envolvem um grande fluxo de matéria prima e mão de obra. Os resultados desta pesquisa servem tanto para rever e analisar os custos totais de fabricação dos itens produzidos na empresa. E também para futuros estudos econômicos da cadeia produtiva, criando uma referência acadêmica no assunto.
Palavras-chave: Beneficiamento têxtil; Custo unitario; Mão de obra.

Resumen
Este tema se aborda a través de un estudio de caso de una industria textil, ubicada en São Paulo. El proceso de beneficio textil fue seleccionado para analizar su capacidad. La elección de estas etapas de la cadena productiva se basa en que son los principales procesos productivos dentro de la empresa que involucran un gran flujo de materia prima y mano de obra. Los resultados de esta investigación sirven tanto para revisar como para analizar los costos totales de fabricación de los artículos producidos en la empresa. Y también para futuros estudios económicos de la cadena productiva, creando un referente académico en el tema.
Palavras clave: Procesamiento de textiles; Costo unitario; Mano de obra.

1. Introduction

Brazil's first facilities for textile industries were established in the mid-19th century, based on population growth and the consumer market. Such enterprises were temporary and minor. With the first world war, there was a decrease in imports and the use of installed capacity in the textile sector, generating possibilities for easy credit and monopoly in the domestic market. After the war's end, this sector's productive ability fluctuates (Clementino, 2012). The Brazilian textile industry would develop by the end of the 19th century when the suspension of customs tariffs on imported machinery served as a stimulus for the creation of cotton weaving and spinning mills. Since the 1990s, when the country opened to foreign products, the textile and clothing industry has been impacted by low-cost imported items (Garcia, 2014), making cost control very important for the sector.

The textile chain in Brazil is the most complete in the western hemisphere (Fujita & Jorenete, 2015). The sector contributed US$ 31 billion in 2020 to the Gross Domestic Product (GDP), a number that suffered a drop due to the pandemic, and is home to about 25 thousand companies, still being the 2nd largest employer in the processing industry, following beverages and food. In addition, Brazil is considered the largest complete textile chain in the West since it counts from producing fibers, such as cotton plantations, to the parades of fashion through spinning, weaving, processing, clothing, and strong retail (ABIT, 2022). A produção de tecidos sintética e em algodão movimenta US$ 797 bilhões no mundo (Amaral et al., 2018). Cavalcanti and Santos (2022) analyzed data from IEMI (2018) on sales of textiles and clothing in the international market between 1950 and 2017 and concluded a movement of US$ 781.7 billion in 2017, of which 58% clothing and 48% textiles. These numbers show Brazil in 5th place in the world ranking of the textile industry, responsible for 2.4% of production, and 4th place in the clothing industry, with 2.6% of world production (Cavalcanti & Santos, 2022). According to the UN (2018), the waste produced in the world reaches 10 million tons per day, which results in two billion per year, and Abrelpe (2018) estimates the Brazilian share at 215,000 t/day of waste. Brazilian entities point out that the damage caused by not recycling waste (80 million tons per year) reaches US$ 40 billion annually. The reverse logistics in Brazil started in 2010 (BRASIL, 2010), which led to the process in some industrial segments, including agrochemicals, tires, and batteries (INPEV, 2019). However, this movement is still developing in the textile industry, requiring a transition to the circular economy.

The textile and clothing chain is one of the most polluting. It appears as a significant generator of waste caused in the various production processes, with losses from the production phase to the market, including the incorrect disposal of materials and leading to industry financial losses and garbage. Lima et al. (2022) state that innovative methods must consider the circular production model, making the raw materials cleaner and more sustainable. The authors analyzed the literature between 2010 and 2021 on applying the circular economy in the textile industry and solid waste. They found an increase in scientific production between 2019 and 2022. 2021, with emphasis on Europe, which holds 60% of the studies, and 33 countries were found 165 researchers working on the topic. Innovation is one of the critical factors for the transition to a circular economy in the textile and clothing chain. 3D printing is already used to reduce fabric waste in the manufacturing process and enables production customization (Carlota, 2018). This technology lowers waste materials' disposal and production time because adjustments are made to the modeling before making it in the customization phase. The introduction of robots in the textile industry processes, the sewbots, help from the confection to the labeling and the control of production and inventories (Cavalcanti & Santos (2022).

The correct identification of costs is essential as they directly reflect the constitution of the sale price, in addition to interfering with organizations' profitability, competitiveness, and health. In specific terms, labor is one of the factors that directly intervenes in the cost. According to Dutra (2009), labor costs are the amounts allocated to the remuneration of workers involved in the production, commercialization, and administration process, among others, to obtain goods and services. In addition to direct and indirect subdivisions, direct labor consists of the workforce performed on the premises to produce goods and services. In contrast, indirect labor has a workforce related to administration and marketing. In the view of Santos et al. (2006), indirect work consists of other expenses, such as personnel, that can be measured only by apportionment and not by unit. Sá & Padroni (1984) emphasize that there must be effective control of labor to promote accurate data on production costs since, according to Bernardi (1996), labor is generally not accounted for since it is one of the performance drivers for companies. Souza (2011) inferred the structure of costs and expenses of companies in the textile and steel/metallurgy sectors from 2005 to 2009 and related this structure to profitability and operating profitability. The author presented quantitative modeling and regression analysis with panel data using a fixed effect model, with a constant slope and intercept varying between entities.

Understanding the correct application of Production Planning and Control (PPC) techniques might help reduce losses, increase economic benefits, and help reduce waste. This study aims to conduct a financial analysis of the stages of textile processing. The present case study details the textile processing process, thus contributing to academic knowledge so that companies in this sector, considered a significant generator of jobs in Brazil (ABIT, 2018), become economically more efficient. The research helps any study or textile company forecast the costs of the manufacturing process steps and avoid losses.

2. Methodology

This is a case study in the textile industry to find out the losses that occurred in the production process. To reach our objective, we conducted an economic analysis of the costs of each step and identified the failures in each cycle, followed by the final product manufacturing cost calculation.

In this case study, an analysis was made of the cost of inputs, including chemicals, labor, energy, and the value of raw materials (cotton and polyester yarns). To estimate the product cost per linear meter, consider the material losses in the beneficiation process. The study stages were (1) to perform a flow balancing, (2) to survey the production process costs and expenses, and (3) to simulate the cost of the product using 100% of the installed capacity. The productive capacity of each unit was obtained through the quality sector that operates in the company (Table 1).

Table 1 - Monthly goals of each division (20 working days).

Production unit	Production (m 10^3)
Weaving	1,100
Winder	1,100
Pre-targeting	1,188
Stamping	1,200
Finishing	1,400
Revision	1,600

Source: Authors.

2.1 Cost and Expenses

The purpose of this study will not be the conceptual discussion of costs and expenses, the concept of cost is related to the production process and the expense within other procedures, such as, for example, in the processes of administration and commercialization. The difference between costs and expenses is that the former represents the monetary expression of consumption and the use or transformation of resources in producing goods or services. At the same time, the second represents the economic expression of consumption, use, or conversion of resources in the process of the general management of the organization and other methods that occur after the production of goods and services (Martins & Rocha, 2010). The authors separate fixed costs and expenses into two types: (a) structural: necessary to support and related to maximum capacity, and (b) operational: necessary for the operation of the facilities and are not necessarily related to maximum capacity (Figure 1).

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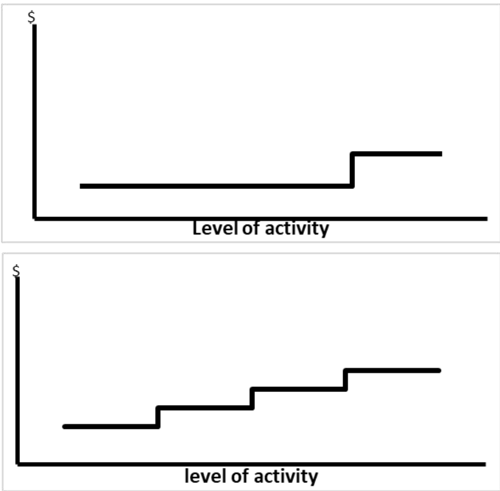
Figure 1 - Cost behavior and fixed expenses.



(a) Structural fixed costs and expenses

(b) Operational fixed costs and expenses

Source: Adapted from Souza (2011).

Fixed costs are resources consumed, used, or transformed, not affected by volume within a specific range of activity levels (Martins & Rocha, 2010). Analogously, fixed expenses are monetary expressions of the consumption of resources in the organization's management process and other processes that occur before and after the production of goods and services, which are not affected by the volume of output within a specific range of the level of activity (Souza, 2011). We can see in Figure 1 that the structural fixed costs and expenses are not directly related to the production of a production unit. However, they are necessary for maintaining the productive system associated with the maximum production capacity.

Operating fixed costs and expenses are directly associated with the production level of goods and services, and not the high prices were obtained through company assistance, including labor, chemical, and energy costs. The labor cost was considered for people directly linked to the production process. The calculation was based on the number of people for each machine to work simultaneously – the company's human resources department (HR) obtained data. The base salary for employees in the category was considered.Para o calculo de energia, os dados foram fornecidos pela empresa.

The company has several sectors in addition to textile processing. Fortunately, an energy consumption meter was installed for each sector, which made it easier to calculate the energy consumed in the textile processing process. Finally, the packaging price was considered to pack a certain amount of meters using cardboard cylinders and a plastic package. The cost of chemical products used in each stage will be presented through the recipes used for each production stage, facilitating the calculation of their consumption.

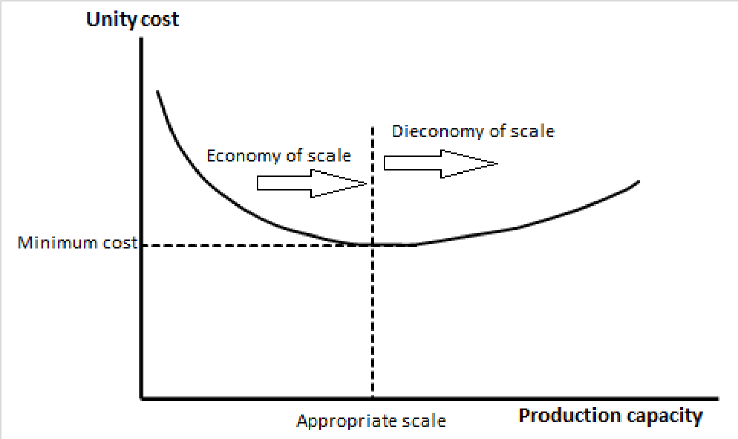
The unit cost method was used to calculate the product's final cost. It is calculated through the ratio between the estimated total costs and the number of items produced (Bornia, 2010). Total costs, for analysis purposes, can be divided into fixed costs – they exist independently of the volume produced – and variable costs – which depend directly on the number of units produced (Slack et al. 2009). Equation 1 explains that fixed costs are diluted as the quantity produced increases (Slack et al., 2009).

$$u(q) = \frac{V(q) + F}{q} \tag{1}$$

where u = Unit cost depending on the quantity produced; q = amount produced; V = variable cost depending on the quantity produced; and F = fixed cost.

Figure 2 shows a point at which unit costs would be minimal. For Casarotto (2011), the "optimal" scale would be precisely the one that results in the minimum point.

Figure 2 - The point where the unit cost is minimal.



Source: Adapted from Casarotto (2011).

2.2 Data on the Enterprise

The object of study is a company that operates in the bed, table, bath, and decoration segment, located in São Paulo, Brazil. This company has an installed production capacity of 2 million meters of fabric. The fabric flow to be studied represents about 70% of the company's total production, composed of cotton and polyester yarn. The fabrication flow of this fabric starts from the weaving process, passing through the textile processing, as pointed out in the line shown in Figure 3. A previous study carried out a shrinkage analysis on various production orders (Martins & Rocha, 2010). Figure 4 shows the flowchart of the textile processing process, starting with weaving, pre-bleaching, printing, finishing, and finally, the review of the product obtained in this flow.

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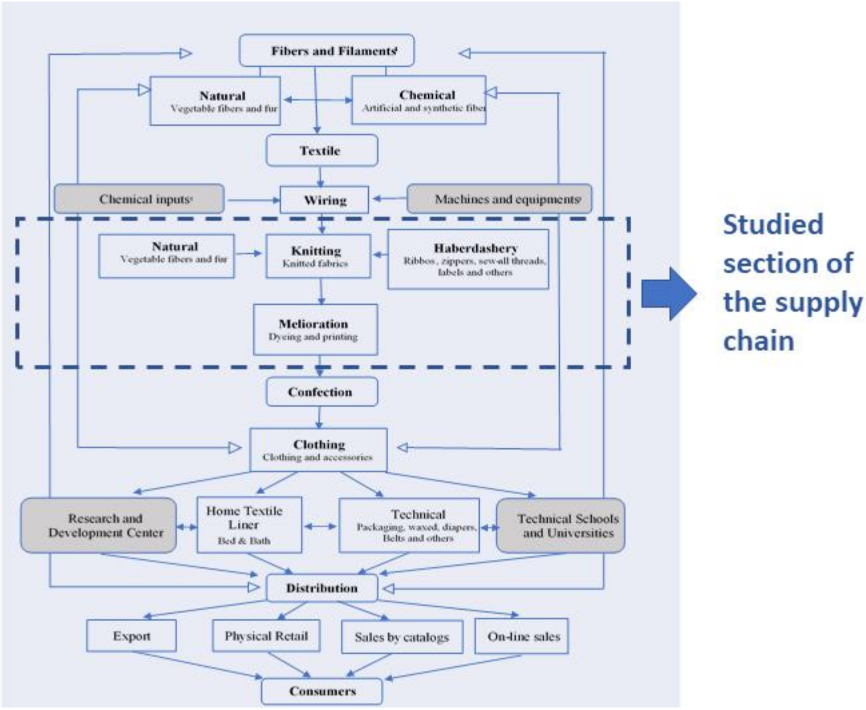
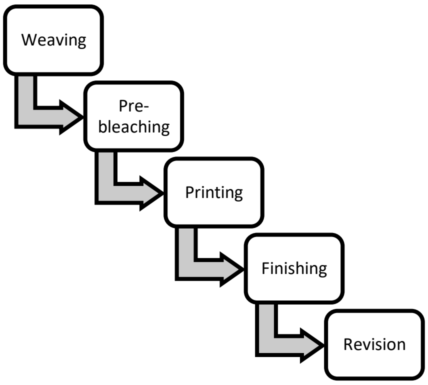
Figure 3 - The textile and clothing production and distribution chain.



Source: Adapted from Garcia (2014).

Figure 4 - Stages of the fabric processing flow in the textile production and distribution chain.



Source: Authors.

The processes for this industry flow start from receiving the cotton yarn representing the weft with a titer of Ne 30 and the polyester thread, meaning the warp in the fabric with a titer of 300/75. The polyester yarn goes through a warping process where the yarns are wound on a material carrier called a spool to be fed into the looms. After the threads are passed through the warper, the weaving begins, transforming them into the flat fabric. The characteristics of the fabric obtained are shown in Table 2.

Table 2 - Data on the fabric characteristics.

Dimension	Measures
Length (m)	2.63
Square weight (g/m^2)	83
Composition	50%CO, 50%PES

Source: Authors.

The fabric pieces obtained are grouped to form a roll of fabric with a length of 15000 meters through a winder machine. In the pre-bleaching process, the material goes through a device called 'Lavadeira Extracta". The fabric is pre-bleached using only an emulsifier to extract excess oil and impurities present in the fabric, then dried. The material goes on to the printing process, where a rotary pigment printer is used. After printing, the fabric receives a final finish and gains dimensional stability. In the last step, the material is reviewed and classified as first quality, first choice, and retail.

2.3 Cost Analysis

- Labor cost

There is an ideal framework for operators to carry out the process for each industrial process. The company's HR department obtained the data, and Table 3 shows the workers for each process.

Table 3 - List of operational staff.

Process	**Operators Table**
Weaving	50
washing	5
stamping	20
Finishing	7
Revision	5

Source: Authors.

- Input

For the pre-bleaching process, Table 4 shows the processed material's chemical and water consumption ratio per linear meter. The average water consumption for this type of machinery was estimated at 4L per kilogram of material.

Table 4 - Chemical and water consumption ratio in the pre-bleaching process.

Items	Cost per linear meter R$/m
Chemical product	0.0133
industrial water	0.0042

Source: Authors.

For the stamping process, data were collected, and an average of the different types of stamps was calculated. Table 5 shows the stamping cost per linear meter of fabric.

Table 5 - Cost ratio of inputs in the stamping process.

Items	Cost per linear meter R$/m
Chemical product	0.2500

Source: Authors.

In the final finishing process, where the fabric receives the specific type of finish for the article and the dimensional stability, the following table shows the relationship between the cost of inputs per linear meter of fabric.

Table 6 - Cost ratio of inputs in the finishing process.

Items	Cost per linear meter R$/m
Chemical product	0.0529
Industrial water	0.0009

Source: Authors.

In the review process, two types of inputs are used for packaging the final product; the following table shows the packaging costs:

Table 7 - Cost ratio of inputs in the review process.

Item	Cost per linear meter R$/m
Cardboard and plastic packaging	0.0049

Source: Authors.

In the weaving and winding process, no type of input is used, so it was disregarded.

- Energy

The total consumption of electrical energy for the entire flow was considered. And it was estimated at R$96,000, and the cost of natural gas at R$400,000. was considered fixed and not related to the level of activities because the company works only one shift. In the case of the increased simulation, the production will be considered the same.

3. Results and Discussion

3.1 Result considering one-month production:

According to Table 8, the production of a certain month was raised in linear meters to simulate the product's final cost.

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Table 8 - One month's production, considering 20 working days.

Industrial process	Quantity produced (m)
Weaving	457,814
Winder	457,814
Pre Bleach	508,525
Stamping	570,646
Finishing	610,993
Revision	591,994

Source: Authors.

Based on the production data presented in Table 8, we can calculate the cost of the linear meter of fabric at each stage of the flow; the result is shown in Table 9. The production of 611,000 m of material was considered the basis of calculation to calculate the unit cost, as this is the production collected in a specific month. According to Equation (1) we can calculate the unit cost:

$$u(q) = \frac{0.32*(611{,}000)+400{,}000+261{,}000+96{,}000}{611{,}000} \quad (1)$$

$$u(q) = 1.56$$

We can see that the unit cost is 1.56 R$/ linear meter. However, this calculation considered that the plant is working with 55% of its installed capacity, indicating that the unit cost can be reduced by increasing production. Then we will do a simulation with an increased production reaching 70, 80, 90, and 100% of the plant's productive capacity, applying the same method used above. When considering 70% of the plant's production capacity, u(q) = 1.30, and applying 80% of the plant's production capacity, u(q) = 1.18. For 90% of the plant's production capacity, u(q) = 1.08, and at full capacity u(q) = 1.01. It is observed that the unit cost decreases as the production reaches its maximum capacity.

According to the above results, the unit cost decreases as production reaches its maximum capacity. As Casarotto (2011) mentioned, there is an appropriate point where the unit cost will be the minimum. And in this case, the maximum production of the installed capacity and the right moment. After this point, it will be necessary to increase the investment as expanding the work shifts will cause the unit cost to rise and move away from the appropriate point, as shown in Figure 2. In Figure 2, we can see how the unit cost decreases as the production capacity increases. The percentage of breakage was done in a previous study, which would have to be considered.

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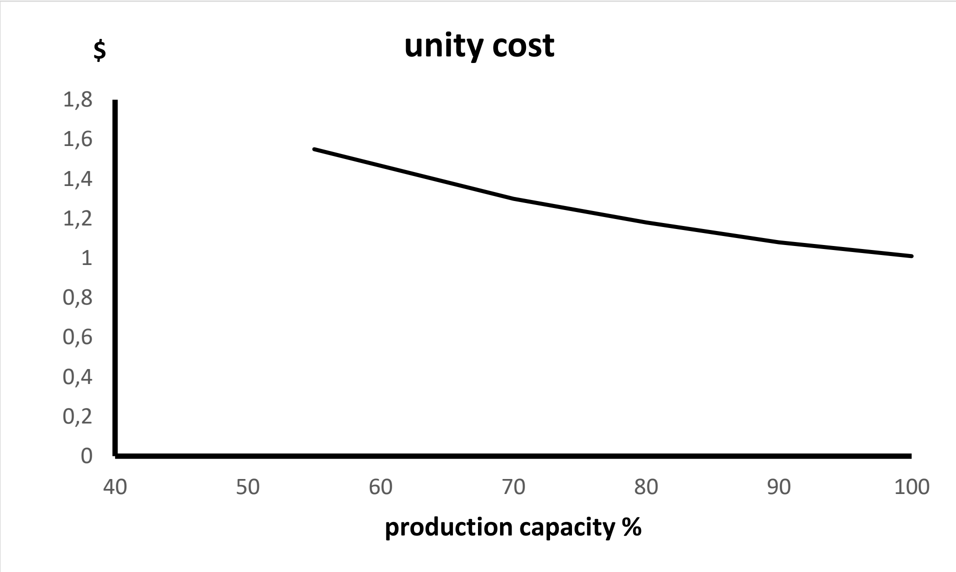
Figure 2 - Simulation of unit cost *vs.* production capacity.



Source: Authors.

By applying the percentage of this process loss obtained from the previous study estimated at 4.5%, the cost with the production capacity of 55%,70%, 80%,90%, and 100% become, respectively, 1.63R$/m, 1.36R$/m, 1.23R$/m, 1.12R$ and 1.05R$. Casarotto (2011) states that labor costs do not offer large variations in the capacity utilization level nor determine significant influences on fixed production costs, allowing factory size to adjust without changing the company's cost structure. Another assumption by the author would be to adopt new shifts, emphasizing that night work raises the cost of labor, corroborating Ferrati et al. (2018). They place the night shift premium as one of the factors contributing to increasing the cost of labor in production. Our results agreed with Casarotto (2011), corroborating that the unit cost decreases as production capacity increases. Either the company's installed capacity is increased or the utilization rates are improved, as can be proven by the possibility of reducing waste and forwarding the waste to return to production processes. The study by Souza (2011) demonstrated that the cost structure in the textile sector has a range of composition of the cost and expense structure between 20.15% and 20.76% of fixed costs, and expenses are between 79.85% and 79.24% of variable costs over total costs. Souza (2011) concluded that it could not be said that the maintenance of fixed costs and expenses (CDF) between 20.15% and 20.76% of textile companies from 2005 to 2009 is sufficient to improve performance above the average of the textile sector studied. Its contribution, however, serves as a parameter for the adoption of cost analysis and decision-making strategies, as can be understood in the present study. Ferrati et al. (2018) studied labor costs in textile companies in Santa Catarina. They concurred with the same result when calculating the cost per hour of employees among other studies, such as the influence of social charges on this cost, a component not studied in this research. As Fleury et al. (2007) and Cavalcanti and Santos (2022) present, the Brazilian textile sector focused on the national market, allocating about 3% to exports. The acquisition of foreign companies and the installation of offices in countries such as the United States and Argentina are not enough for the internationalization of the sector.

Competitiveness and competitive advantage are established by pursuing objectives that lead to more responsible management and better corporate governance. Cavalcanti & Santos (2022) present innovation and quality standards among the indicators to be evaluated to understand the dimensions of production, which can be characterized as a set of competitive needs. Such a position corroborates the idea of this study on the importance of strict cost control in the studied phases of the textile industry. Souza (2011) showed that cost control provides information contributing to strategic decisions and seeking appropriate tools to improve organizational performance. This study shows the need for cost control for the company's best performance in the schedule. Like Ferrari et al. (2018), we found a lack of scientific studies dealing with costs, especially in the textile industry. The present study supports empirical studies on the relationship between costs and material losses, which could return to the production cycle and enable a transition path to circular production in the sector studied.

4. Conclusion

With the analysis carried out, the variation of the final cost of the process is observed by applying the unit cost method. and the results show that the variable cost of production resulted in 20.5%, as mentioned by Souza (2011).

References

ABIT - Associação Brasileira das Indústrias Têxteis e de Confecção.(2022). Perfil do setor. https://www.abit.org.br/cont/perfil-do-setor.

ABIT - Associação Brasileira das Indústrias .(2018). Têxteis e de Confecção. Perfil do setor. https://www.abit.org.br/cont/perfil-do-setor.

ABIMAQ – Instituto de Pesquisa e Desenvolvimento Tecnológico da Indústria de Máquinas e Equipamentos. .(2018). Perfil do setor [página na internet, acesso em 13 maio 2018]. https://www.abimaq.org.br.

ABRELPE. Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais. .(2018). Panorama dos Resíduos Sólidos no Brasil. São Paulo, 2017. Disponível. Centro universitário de anapólis–unievangélica programa de pós-graduação em sociedade, tecnologia e meio ambiente (ppstma), 17 , 2018.

AGÊNCIA BRASIL – Agência Pública de Notícias da EBC. .(2018). Perfil do setor. https://www.agenciabrasil.ebc.br.

Bernardi, L. A. .(1996). Política e formação de preços: Uma abordagem competitiva, sistêmica e integrada. Atlas, 1996. 355.

Bornia, A. C. .(2010). Análise gerencial de custos: Aplicação em empresas modernas. (3a ed.). Atlas, 2010. 232.

Carlota, M. C. .(2018). A Indústria 4.0 aplicada aos Setores da Moda (Doctoral dissertation), 2018.

Casarotto Filho, N. .(2011). Elaboração de Projetos Empresariais: Análise Estratégica, Estudo de Viabilidade e Plano de Negócio. Atlas, 2011.

Cavalcanti, A. M., & Santos, G. F. (2022). A indústria têxtil no Brasil: uma análise da importância da competitividade frente ao contexto mundial. Exacta, 20(3), 706-726. https://doi.org/10.5585/exactaep.2021.17784.

Clementino, M. do L. .(2012). A evolução da indústria têxtil no contexto da afirmação do impermealismo americano. Bagotá: XII coloquio de geocrítica, 2012.

Dutra, R. G. .(2009). Custos: uma abordagem prática. (6a ed.) Atlas, 2009. p. 422.

Felix, A F S R .(2022).. Industria 4.0: Desafios e Oportunidades para a Industria Têxtil no Brasil. Universidade Federal do Rio Grande do Norte. Natal – RN, 2022.

FLeury, L. C., & Almeida, J. P. D. (2007). Populações tradicionais e conservação ambiental: uma contribuição da teoria social. Revista Brasileira de Agroecologia, 2(3), 3-19.

Fujita, M., & JorentE, M.J. .(2015). A Indústria Têxtil no Brasil: uma perspectiva histórica e cultural. Moda Palavra e-Periódico, 8(15), 138-160.7

IEMI – Inteligência de mercado. Perfil do setor [página na internet, acesso em 10 de outubro 2018]. Disponível em: https://www.iemi.com.br

INPEV – Instituto Nacional de Processamento de Embalagens. .(2019). Perfil do setor [página na internet, acesso em 05 agosto 2019]. Disponível em: https://www.inpev.org.br.

GArcia, S. .(2014). Sustentabilidade e inovação em segmentos da cadeia de moda. 2014.

Lima, I. L. P. ., Silva, T. S. Da ., & EL-Deir, S. G. (2022) Aplicação da economia circular nos resíduos sólidos da indústria têxtil: bibliometria entre 2010 e 2021: application of the circular economy in solid waste from the textile industry, bibliometry between 2010 and 2021. Revista Brasileira de Meio Ambiente &amp, Sustentabilidade, 2(2), 5–27, 2022. https://rbmaes.emnuvens.com.br/revista/article/view/202.

Oliveira, T. A. B., & Amaro, D. R. A. (2022). Análise do Planejamento e Controle da Manutenção na Industria Têxtil. Centro de Trcnoligia. Universidade Federal do Rio Grande do Norte. Natal – RN, 2022.

Martins, E., & Rocha, W. .(2010). Métodos de custeio comparados: custos e margens analisados sob diferentes perpectivas. Atlas, 2010.

SÁ, A. L. de, & Padroni, G. .(1984). Administração e organização e contabilidade de custos do trabalho: custos da mão-de-obra e estruturas da organização do trabalho aplicados às pequenas e médias empresas. Tecnoprint S.A, 1984.

SAntos, J. L. dos, Schimidt, P., Pinheiro, P. R., & Nunes, M. S. .(2006). Fundamentos de contabilidade de custos. Atlas, 280.

Slack, N., Stuart, C., & Johnston R. .(2009). Administração da Produção. (3a ed.) Atlas, 2009.

Souza, B. C. .(2011). Relação da estrutura de custos e despesas com a rentabilidade e lucratividade operacional nos setores têxtel e siderúrgico/metalúrgico no Brasil no período de 2005 a 2009.

Souza, B. C. (2011).. Relação da estrutura de custo e despesa com a rentabilidade e lucratividade operacional nos setores têxtil e siderúrgico/metalúrgico no Brasil do período de 2005 a 2009. Tese de doutorado. Departamento de Contabilidade e Atuária da Faculdade de Economia, Administração e Contabilidade da Universidade de São Paulo c / Bruno Carlos de Souza.

Un, C. A, & Rodríguez, A. .(2018). Local and global knowledge complementarity: R&D collaborations and innovation of foreign and domestic firms. *Journal of International Management*, 24(2), 137-152, 2018.