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PROPOSALS FOR IMPROVEMENTS IN THE MANUFACTURING PROCESS OF TRADITIONAL SADDLES: A CASE STUDY IN A SADDLERY IN MARABÁ - PA

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ABSTRACT

One of the tools that make business detailing possible is process mapping because it allows identifying the improvements that can make the process under analysis more efficient and effective. Thus, this paper studies the Process Mapping application as a tool for analyzing the productive process of traditional saddles in a saddlery in the city of Marabá, PA. A process diagnosis with mapping was performed using the flowchart and spaghetti diagram techniques, which identified the main flaws in the process. In the MS Visio software, the flows were drawn, thus allowing a graphic visualization of the entire process. In addition, an action plan was prepared, using the 5W1H tool, through which it was possible to propose improvements for the studied process. With the development of this work, problems such as great movement during the process and a considerable amount of waiting were detected, allowing us to propose solutions for them, thus ratifying the mapping as a tool to support the decision-making process of the company's operational planning.

Keywords: Process Mapping; Saddlery; Flowchart; Spaghetti Diagram.

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INTRODUCTION

One of the sectors that move the Brazilian economy is agribusiness, with agriculture and cattle breeding as the main activities ranging from cultivating the field to rearing animals.

Agribusiness is a sector of great importance to Brazil, as can be seen by the fact that from 1995 to 2015, the sector represented, on average, 21.7% of the Brazilian Gross Domestic Product (GDP) (CEPEA, 2016).

The sector developed and modified itself, becoming a broad system, and consequently required a greater number of products and services that go beyond rural properties. Thus, it required larger structures, better cultivation techniques, research, and collaboration for the Brazilian agribusiness to result in benefits (ABAGRP, 2016).

One of the segments of agribusiness, horse breeding, occupies a prominent position in Brazil, contributing to the maintenance of the livestock sector, among other everyday activities. Junior and Murad (2016) state that "equines are present as guides and food sources in transportation and public protection, in religion, sport, medicine, history, and culture [...]."

It is noted that, due to the great demand, numerous business opportunities arise from equine breeding. One of these markets is saddlery and accessories, which, according to Dias (2016), had one of the largest contributions to the horse industry chain, corresponding to 2.33% and a total of 12,000 direct jobs.

The relevant economic movement of the saddlery segment has aroused interest in the manufacturing of saddles and accessories to meet market demand. However, investors and administrators do not always have a large amount of capital for investments in technologies or a level of managerial knowledge capable of providing improvements in performance and reaching the desired goals.

In this context, given the impact that the saddlery segment has on the national economy, companies operating in this supply chain are increasingly seeking ways to improve the production process. A technique that is widely used in the study of production processes is process mapping, which consists of drawing the information flows, materials, and work along the processes, and these are recorded so that other people can understand them (Costa and Politano, 2008). Therefore, studies should be conducted so that the saddlery segment develops more and more with improvements provided by tools applied to process management.

For problems to be solved, they must be identified and known. Therefore, mapping processes is an efficient and organized way to improve business management, generating maturity and positive results through analyses that allow identifying, prioritizing, understanding, and solving problems (Accioly, 2016).

In this context, the present work aims to propose improvements to the traditional saddle manufacturing process in a saddlery in Marabá-PA, using process mapping.

This paper was divided into five sections to achieve the proposed objectives. The first section comprised the introduction and objective of the study. Next, the literature review used in the work development, which addressed themes such as Process Mapping and the Horse Market in Brazil, was presented. The third section describes the research methods used in the study and the data collection and treatment methods. The fourth section presents the case study, where the history and characteristics of the company's line of business were exposed, along with the current way in which the production process of the targeted product occurs, in addition to the results obtained from the mapping of the production process of the traditional saddle and the proposals for improvement plans. The fifth and last session is composed of the authors' final considerations and their criticisms and suggestions for future studies.

THEORETICAL FRAMEWORK

Process Mapping

According to Lira (2015), process mapping is a support tool (in written or visual form) to understand processes and their relationships. Thus, companies can have a clearer view of the process in addition to the benefits of mapping.

When a process is represented, it is noted that some of the problems identified were already known. However, measures could have already been taken to solve the problems in the short term (Dorneles and Gaspareto, 2015). For Schwaab et al. (2013), the gain of this technique is the perception of processes as systems, allowing the visualization of which areas participate in the process and if they add value or not.

According to Bueno et al. (2015), process mapping is necessary for any activity that deals with processes, and it must be clear to reduce errors in a production process.

Concerning the extent or level of detail of the processes to be mapped, there are no rigid rules to be observed. It is the business context and its management needs that will determine the extent and depth of process mapping (Sordi,

2012). Furthermore, according to Sordi (2012), after defining the process to be documented, information must be sought through observations, interviews, questionnaires, and software used, among other ways, to obtain elements to map the current situation of the process, a condition for further improvement. Mello (2011) lists the main mapping steps:

- Determine the process and the tool to be used by delimiting the boundaries;
- Determine its start and end points, as well as its inputs and outputs;
- Determine the level of detail and information needed to build the map, prioritizing relevant information that seeks to answer the reason for the mapping;
- Verify and validate the process map, determining the level of detail and the absence of errors, and ensuring that the map faithfully represents the reality of the system studied.

Flowchart

Barbrow and Hartline (2015) point to the flowchart as the most important graphical part of process mapping, and it is often used for information processing purposes.

It is a tool that provides a view of the whole process through graphical representations, detailing the logical sequence of activities and providing a better understanding of possible problems (Barbará, 2008).

Junior and Scucuglia (2011) affirm that flowcharts may not present all the particularities of a process, but the document works as a "guide" for employees. Moreover, D'Ascenção (2010) proposes some standardized symbols that can be seen in **Figure 1**.

Spaghetti Diagram

A spaghetti diagram is a tool of the lean philosophy that determines the ideal layout based on the distances that are traveled during the execution of a process (Freitas, 2013). According to Deguirmendjiam (2016), this diagram allows visualizing the movement of materials, information, and people throughout the execution of an activity.

According to Tapping and ShuKer (2010), one of the benefits of this tool is the fact that tracing the movement of resources allows the identification and quantification of waste with movement and transportation, i.e., according to Tanco et al. (2013), it facilitates the identification of bottlenecks and opportunities for improvement by reducing unnecessary movements.

In short, this type of diagram contributes to a leaner operation as it clearly expresses the waste that is contained in it (Gastineau, Dietz, and Padley, 2009). **Figure 2** displays an example of a spaghetti diagram.

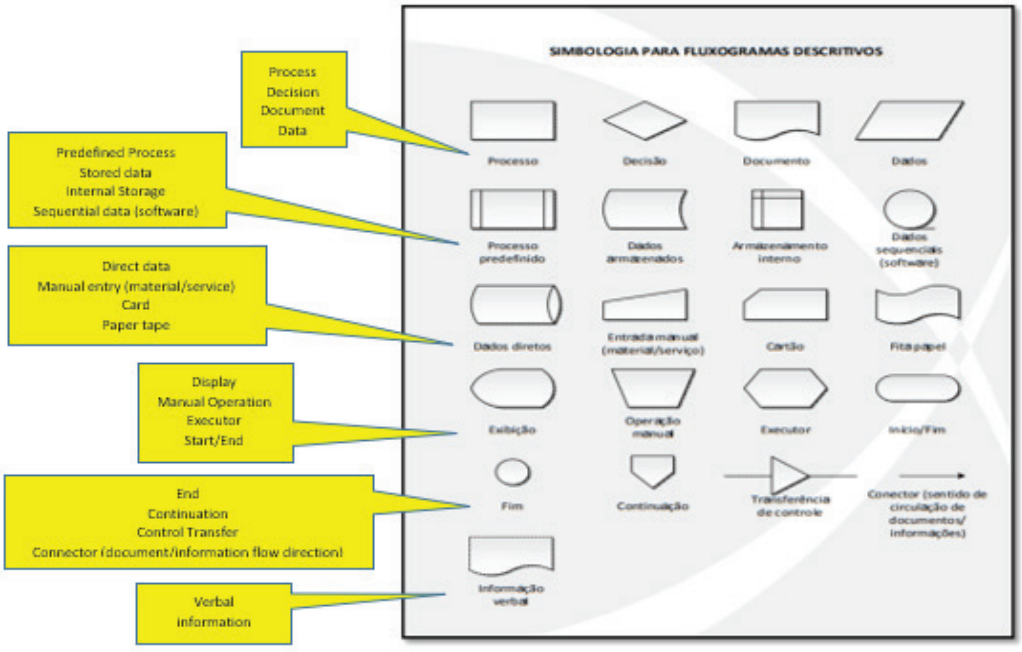

Figure 1. Flowchart Symbology
Source: D'ascenção (2010)

S&G Journal
Volume 17, Number 2, 2022, pp. 121-131
DOI: 10.20985/1980-5160.2022.v17n2.1641

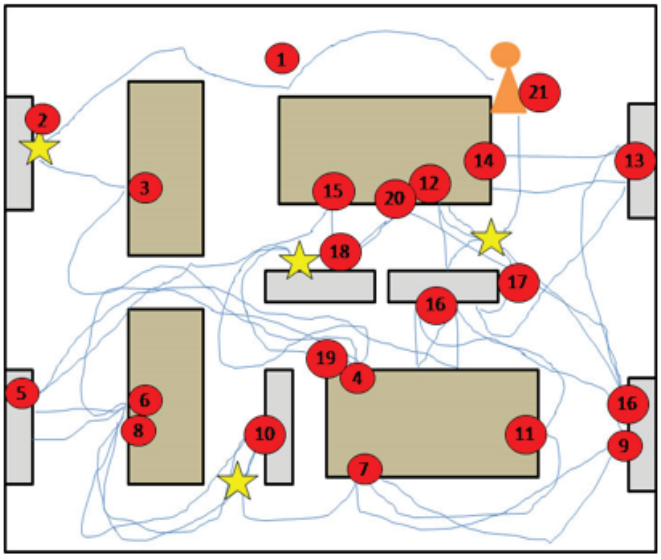

Figure 2. Spaghetti Diagram Symbology
Source: PDCA Home (2013)

5W1H Tool

According to Lisbôa and Godoy (2012), the 5W2H is a tool widely used in practice that identifies which actions should be taken, who is responsible, and the reason for the execution. It is a method composed of seven questions that, when answered, help implement solutions to the problems identified.

Depending on the situation, it can be used as 5W1H, eliminating some factors, as illustrated in **Chart 1**.

5W1H Tool		
5W	*What*	What action will be performed?
	Who	Who will perform the action?
	Where	Where will the action take place?
	When	When will the action take place?
	Why	Why will the action be performed?
1H	How	How will the action be performed?

Chart 1. 5W1H Tool
Source: Adapted from Lisbôa and Godoy (2012)

METHODOLOGY

The present study is about the application of techniques and tools that enable the proposition of solutions for the problems identified in the manufacturing process of traditional saddles in a saddlery. Thus, regarding the nature of the work, it is classified as research of an applied nature since it seeks not only theoretical but also practical knowledge. "*Research of an applied nature aims to generate knowledge for practical application and is directed to the solution of specific problems. It involves local truths and interests*" (Silva and Menezes, 2001, p. 20).

This is a study of interest not only to the researchers but also to the company. The researchers come into direct contact with the environment to be observed, in addition to establishing a relationship with the individuals operating in the process to obtain the necessary data and information for describing the procedures; thus, this research uses a qualitative approach, which, according to Creswell (2007), "*is a means to explore and understand the meaning that individuals or groups attribute to a social or human problem*."

Like qualitative research, it focuses on obtaining data and descriptive information about the subject to be analyzed. One of the most applied procedures, including this study, is the interview, which will provide an understanding of how the whole process is structured.

For the development of this work, an object was chosen for the case study. This procedure is conceptualized by Gil (2010, p. 37) as "*a deep and exhaustive study of one or a few objectives, in a way that allows its broad and detailed knowledge*."

Due to the variety of products manufactured in saddlery shops, besides the several sub-processes until reaching the final product, we chose to study the manufacturing process of the traditional saddle, which corresponds to the company's best-selling product.

Thus, this work contemplates and is limited to analyzing all the processes related to the manufacture of the traditional saddle, such as leather cutting, sewing, assembly, and finishing.

The activities developed for elaborating the research followed the steps below:

- Study of the horse market sector and its segments, focusing on the importance of the saddlery segment in Brazil;
- Evaluation of the productive system studied and the variables involved in the manufacturing process of the traditional saddle (product object of the mapping to be performed);
- The elaboration of the flowchart and spaghetti diagram as initial techniques for the mapping of the process chosen for the study and the use of MS Visio

software as a tool for drawing the current flows of the process studied;

- Evaluation of the results obtained based on the mapping analysis;
- Elaboration of an action plan, employing 5W1H to propose improvements to the manufacturing process.

CASE STUDY

Company presentation

The company where the research was developed has been in the saddlery business for four years, manufacturing riding products and accessories.

The company is located in the southeast of Pará, in the city of Marabá-PA, and operates with four employees, who are a production manager, an administrative employee, and two workers, with a total of eight machines: four sewing machines, a cutting balancer, a chamfering machine, a cutting machine, and an emery iron. The company is managed by the owner and a partner, who are also active in sales, not only in Marabá but also in neighboring cities. The company works especially with pushed production, but it is not restricted to this type of production since, in some cases, it meets the demands of pulled production and orders for customized saddles.

The products manufactured include the traditional saddle, laces, saddlebags, hockstraps, stirrups, riding pants, chocks, baldrames, and basses, among others. This work focuses on the production process of only one of the products, in this case, the traditional saddle for being the most sold product and consequently the most produced by the factory. Sales are made wholesale or retail and occur according to the customer's needs.

To manufacture the saddles, the company maintains a relationship with Goiás, Minas Gerais, and Tocantins suppliers to supply the main raw materials for the products.

Characterization of the operation and the problem under analysis

This study carried out surveys of the steps performed in the saddle manufacturing process of the company object of the study. In the process studied, the main product manufactured is the traditional "*Charuto*" saddle. Due to its higher sales volume, this is the company's most important product.

The process uses buffalo leather, cowhide, shavings, contact glue, steel plate, nylon thread, and rice straw as main inputs. According to information provided by employees, the company has the following main equipment that assists in production: a clicking machine, used for cutting the leather, and an Ivomaq sewing machine, in addition to the tools used in manufacturing: leakers, scalpels, saws, knives, and crimpers. The saddle production process is generally conducted by one employee, occasionally helped by another worker, except for the sweater filling, which is performed by an outsourced employee outside the company.

The studied product has the following parts illustrated in **Figures 3** and **4**, corresponding respectively to the upper and lower part of the saddle.

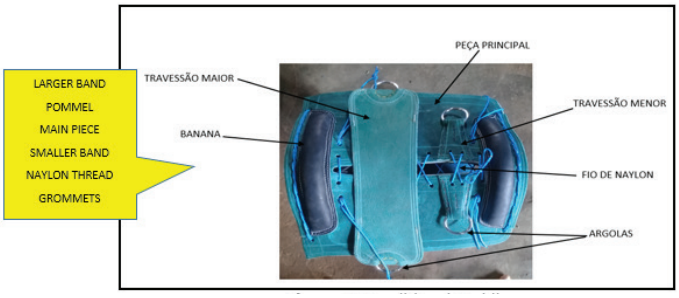

Figure 3. Traditional Saddle
Source: Authors (2020)

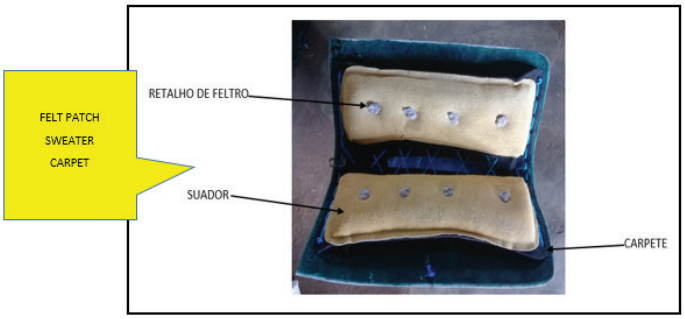

Figure 4. Traditional Saddle Bottom part
Source: Authors (2020)

Process Mapping

After the survey of the stages of process execution, flowcharts were prepared to map the activities pertinent to the manufacturing of the product to identify the critical steps regarding the allocation of the parts manufactured from the raw materials used in its manufacture. Currently, in the company, there is no formal process mapping documentation (flowchart or another resource) that contextualizes these activities, which can bring guidance, simplification, clarity, and efficiency to the processes.

S&G Journal
Volume 17, Number 2, 2022, pp. 121-131
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The production was monitored during an in-loco visit, in which the step-by-step of the manufacturing process was identified, and which, together with the first visit, the observations, and other research, served as a basis for the construction of the flowchart shown in **Figure 5**.

The manufacturing stage begins with the leather selection, which corresponds to buffalo leather. After the leather is selected, it is cut. In this stage, the leather sheet is used to the maximum, i.e., all the leather pieces are cut in the same process. The cutting of the main piece is done manually, and markings are made with the help of a pen and a specific mold. The whole process is carried out in parallel with sub-processes of the other parts that make up the saddle, that is, the cutting step is performed at the same time for all parts, and only the main part is done manually. The other parts are cut in the clicking machine.

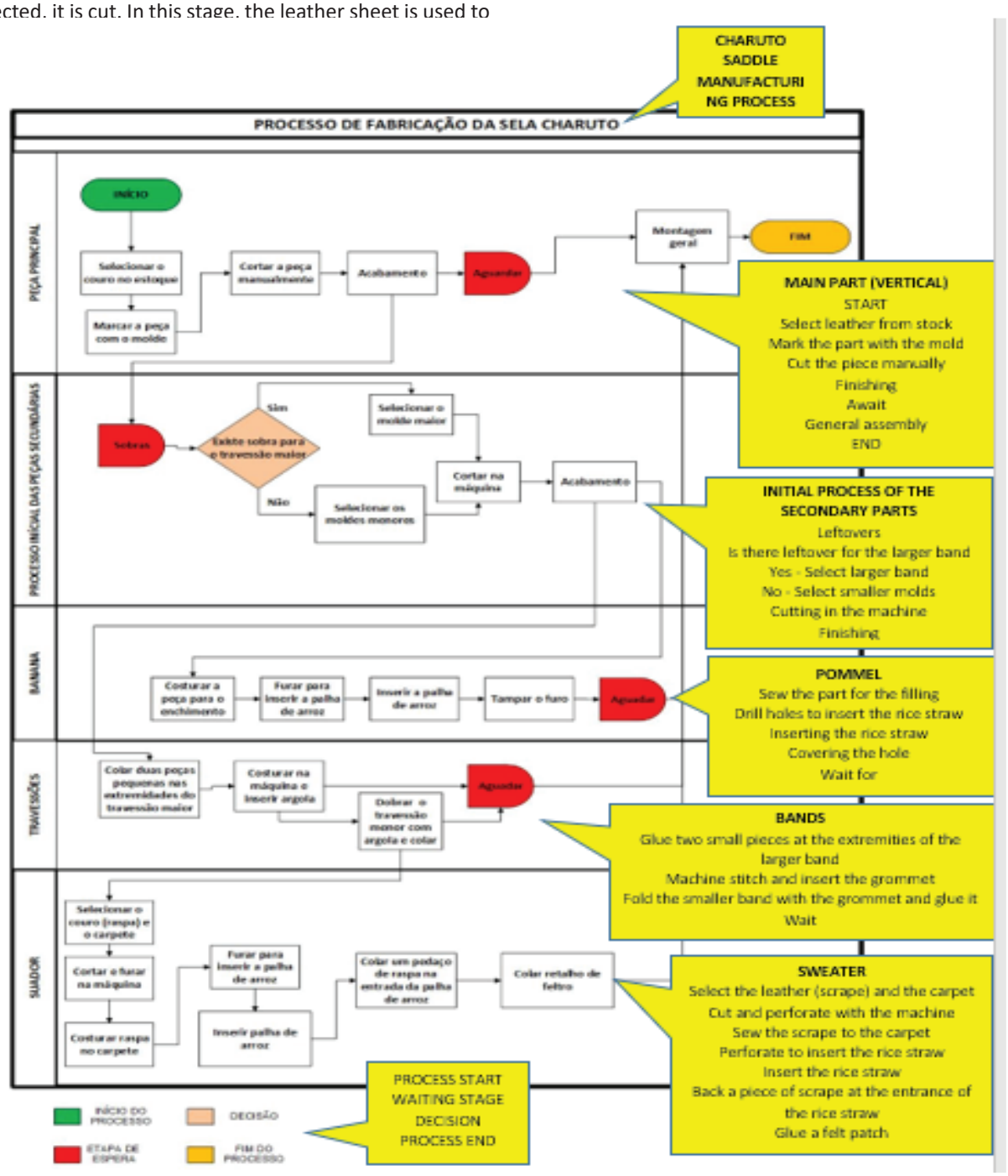

Figure 5. Current Process Flowchart
Source: Authors (2020)

Once all the pieces are cut, they go to finishing, which is done with the help of a scalpel. After this, the pieces are frizzed with the aid of a frizzer. At this point, the employee goes on to assemble the pommel. Subsequently, the larger and smaller bands are finished, parallel to the finishing of the main part. Then it is time to assemble all the pieces, starting the general assembly of the saddle, when the components are joined: main piece, larger and smaller bands, pommel, and sweater. It is finished with the tying of the nylon thread throughout the product.

The saddle production is divided into four sub-processes: the manufacturing of the pommel, the larger band, the smaller band, and the sweater. After these sub-processes, the process continues to the assembly of the saddle.

During the mapping, the movements and total displacements of the operator inside the cell during the operations were recorded using a spaghetti diagram, illustrated in **Figure 6**, in which the yellow flow represents the pommel manufacturing process, the black flow represents the production of the main part and the larger and smaller bands, and the blue flow represents the production of the sweater.

According to the diagram, it was possible to verify that the operator moves for long distances in the space where the process occurs to finish the activities, which is mainly due to the way the physical arrangement and the disposition of the machines and equipment that help in the company's production are structured.

Improvement plan

In this last stage of the application of the proposed methodology, we started to formalize the improvement proposals.

After interviews, the monitoring of processes, and the mapping of the manufacturing stages of the "*charuto*" saddle, it was possible to identify some existing problems, not only in the saddle's production process but also in the entire organizational structure. Among the problems found are the layout organization and the current allocation of machines that result in an excess of movement that could be minimized. Besides this, there are also the problems of stopped machines and unused materials that take up space in places that hinder the circulation through which the processes are performed. Another problem identified is due to the fact that each process is centered on a single employee, because even if a certain product is more in demand, they are all produced with the same labor intensity.

After analyzing the problems to present viable, short-term solutions, the 5W1H tool was used to propose an action plan to improve the company's production system, reducing waste and increasing production.

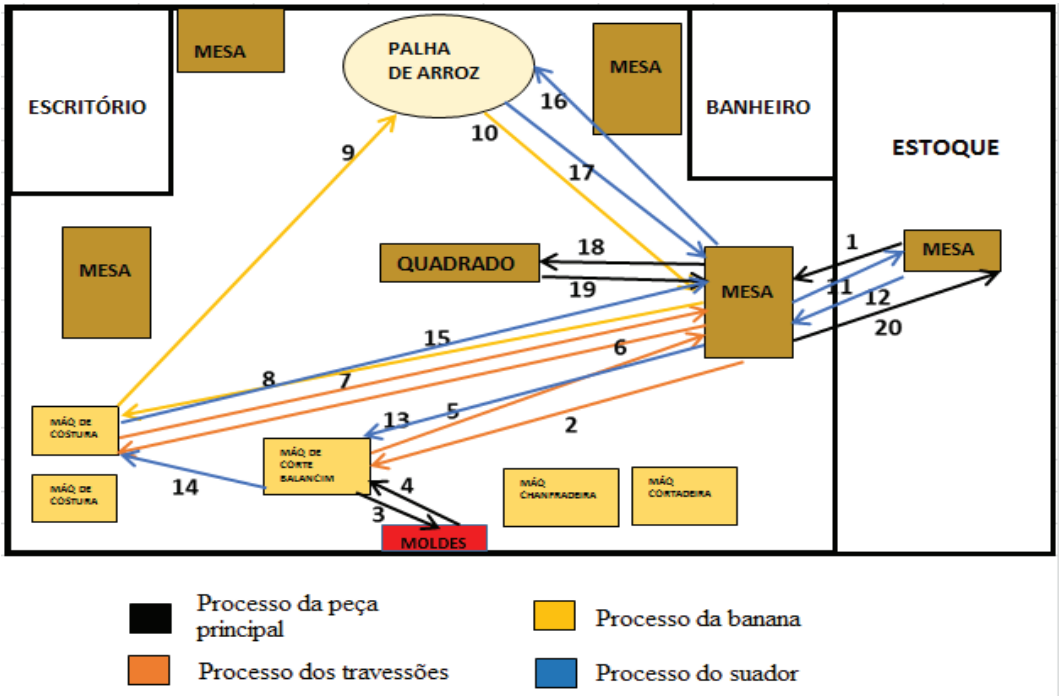

Figure 6. Spaghetti Diagram

Legend: OFFICE; TABLE (5 TIMES); RICE STRAW; SQUARE;RESTROOM; INVENTORY; SEWING MACHINE (2 TIMES); CLICKING MACHINE; BEADING MACHINE; CUTTING MACHINE; MOLDS; Main part process; Band process; Pommel process; Sweater Process
Source: Authors (2020)

S&G Journal
Volume 17, Number 2, 2022, pp. 121-131
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Chart 2 shows the action plans that can be carried out to address the most notorious problems faced by the company.

After the first action plan has been executed, the layout needs to be reorganized since the resources used to manufacture the main product are far apart, causing excessive employee movement. The production manager can consecutively execute the second plan. With the monitoring of the manufacturing process of the saddle, it was noted the need to include an additional employee in the process since there are four stages in which the parts are on hold because it is a single employee performing the stages of the process. Therefore, the insertion of one more employee will reduce the time in which the parts are on hold and will increase the production of this product.

According to the proposed action plan, a new process flowchart was drawn up, as well as another spaghetti diagram, as illustrated in **Figures 7** and **8**, respectively.

Regarding the critical points identified, **Figure 7** illustrates the proposal for inserting another employee into the process, in which a relative wait reduction between processes is noted compared with the current execution shown in Appendix A. With the change, the wait could be mostly extinguished, which would promote an improvement in the efficiency of product manufacturing.

The changes proposed for the layout of the factory floor, illustrated in **Figure 8**, would reduce the distances covered by employees and the excessive movement reported in **Figure 6**.

FINAL CONSIDERATIONS

The main objective of this study was to propose improvements to the manufacturing process of traditional saddles in a saddlery in the municipality of Marabá-PA through Process Mapping using the 5W1H tool.

Through the Flowchart and Spaghetti Diagram tools, it was possible to map the whole process and identify flaws and possible bottlenecks in production. It was observed that it was necessary to reorganize the layout of the factory floor to improve the flow of activities. The division of labor was also observed during the visits, and it was possible to note excessive work for a specific worker, while others were focused on random activities, resulting in idle periods and stopped processes.

To solve or mitigate the problems identified in the company, improvement proposals were made to be used as support tools for the organization in the elaboration of an Action Plan that can help increase both the employees' performance and customers' satisfaction regarding the availability of the products supplied.

Despite the difficulties encountered during the development of this study, such as the change in the company's location and the subsequent difficulty in accessing it, as well as the initial resistance to talking about the process on the part of employees and the work environment itself, which does not have good ergonomic conditions, the objectives that this work set out to achieve were achieved, and it not only provided a model for the company's decision making but also contributed to the literature on process mapping work involving the saddlery market in the State of Pará.

As options for future studies, we suggest the application of the same methodology to other processes in the company, in addition to executing the improvement proposals mentioned in this work to investigate the changes generated to find out if there was an effective improvement in the process. During visits to the factory, it was noticed that the collaborators share the space with stationary equipment and materials that fall through the floor during the processes, besides other materials that have been there for a longer time. Therefore, another proposal would be the 5S methodology, which will provide the collaborators with a more spacious environment and facilitate movement during the processes.

Another problem observed was the absence of a management system for the planning and control of purchases and inventory, which ends up generating a production with numerous stops because this absence causes a lack of inputs for the process, generating ruptures and resulting in production delays. Thus, a study focused on the order point would provide a more detailed view of this deficiency.

WHAT?	WHY?	WHERE?	WHO?	HOW?	WHEN?
Reorganize the layout	To reduce the distance traveled by the employee	On the factory floor	Production manager	Relocating machines to facilitate or reduce movements	01/01/2020
Insert one more employee in the process	To reduce waiting times	On the factory floor	Production manager	Adapting the other employee to the activities of the saddle production cycle.	02/01/2020

Chart 2. 5W1H
Source: Authors (2020)

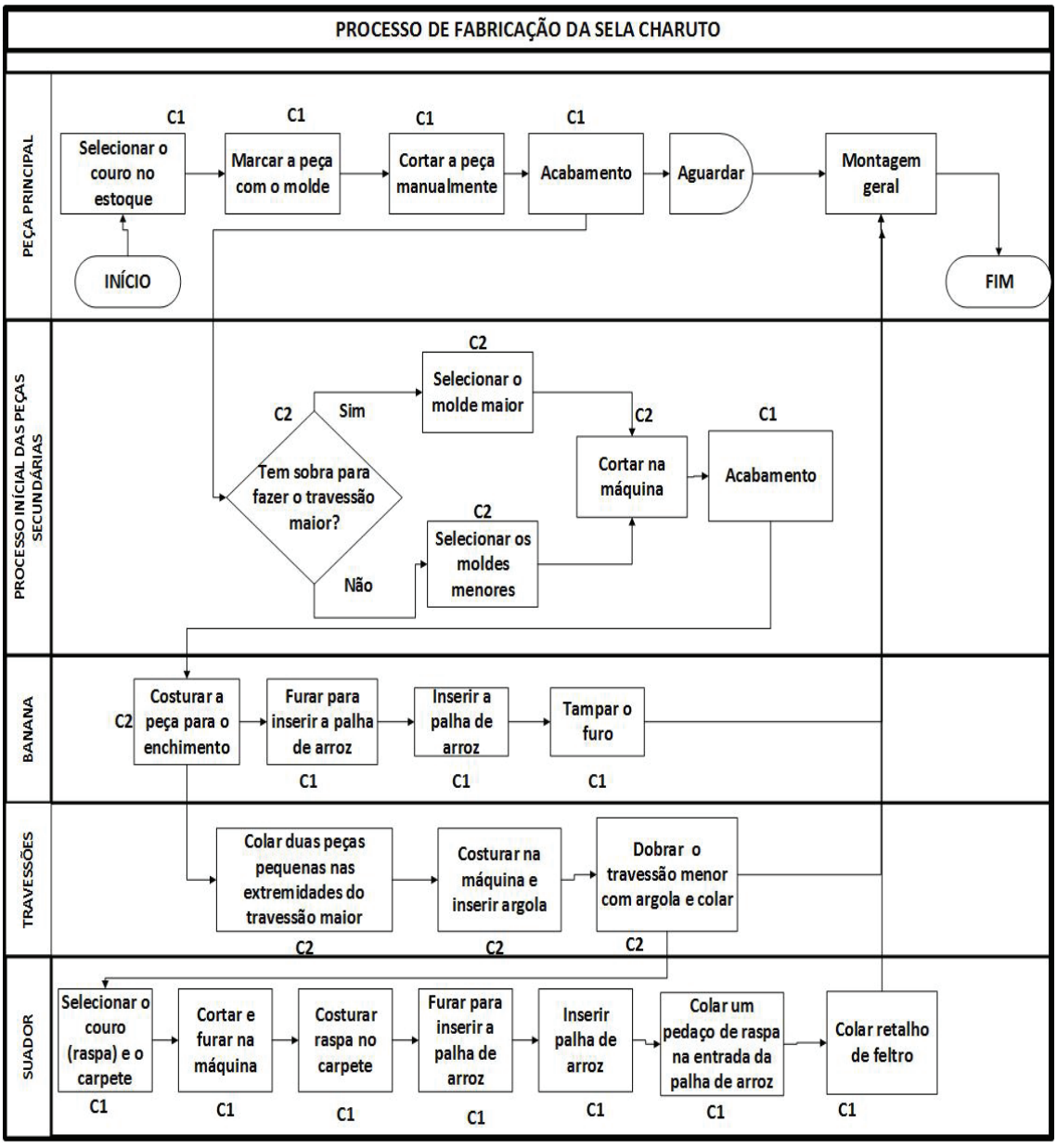

Figure 7. Proposed Flowchart

Legend: MAIN PART; START; Select leather from stock; Mark the piece with the mold; Cut the piece manually; Finishing; Wait; General assembly; END. INITIAL PROCESS OF THE SECONDARY PARTS; Do you have leftovers to make the larger band?; Yes - Select the larger mold; No - Select the smaller molds; Machine cut; Finishing. POMMEL; Sew the part for filling; Drill holes to insert the rice straw; Insert the rice straw; Cover the hole. BANDS; Glue two small pieces to the ends of the larger band; Machine stitch and insert the grommet; Fold the smaller band with the grommet and glue it. SWEATER; Select the leather (scrape) and the carpet; Cut and perforate with the machine; Sew on the carpet; Drill holes to insert the rice straw; Insert the rice straw; Glue a piece of scrape at the entrance of the rice straw; Glue felt patch
Source: Authors (2020)

With the study carried out, it was possible to verify that the company has great potential and market demand but needs to establish goals that meet the demand and reduce waste, in addition to using appropriate policies for incoming and outgoing products. Therefore, we suggest studies focused on demand analysis and inventory management. With this, it is expected that the company will remain in the market, not only meeting the demand it already has but also reaching a larger share of the market.

S&G Journal
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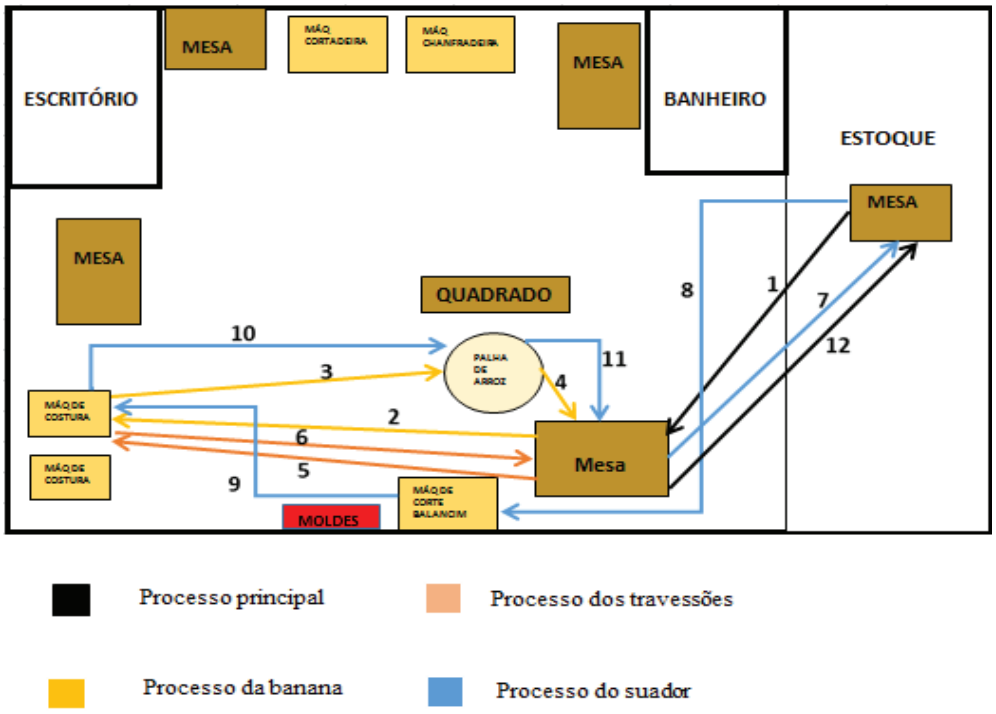

Figure 8. Proposed spaghetti diagram

Legend: OFFICE; TABLE (5 TIMES); RICE STRAW; SQUARE; RESTROOM; INVENTORY; SEWING MACHINE (2 TIMES); CLICKING MACHINE; BEADING MACHINE; CUTTING MACHINE; MOLDS; Main process; Band process; Pommel process; Sweater Process.
Source: Authors (2020)

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