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SOFTWARE ARENA UTILIZADO NO ESTUDO LOGÍSTICO DE FLUXO INTERNO DE CAMINHÕES EM UNIDADES DE BENEFICIAMENTO DE GRÃOS

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RESUMO: A análise logística dos processos produtivos dá suporte na tomada de decisão, prevendo a demanda futura de mercado. Para as cooperativas, é importante esse estudo para estarem preparadas para as próximas safras, atendendo assim os clientes de maneira eficiente, principalmente no pico da safra; onde o a economia de tempo é fundamental para aumentar os lucros e garantir competitividade de mercado. Essa eficácia vai colaborar também para que o produtor consiga seguir com os planos de plantio, otimizando suas safras. O objetivo deste estudo foi analisar o fluxo logístico interno de atendimento, utilizando o software ARENA para simular e averiguar as condições atuais da cooperativa de beneficiamento de grãos, com intuito de encontrar seus pontos fracos. Os resultados obtidos neste estudo mostraram o potencial de contribuição desta ferramenta para o fortalecimento da melhoria logística e maior competitividade dos negócios da cooperativa, despertando para investimento em pesquisas nesta área tão importante presente na pós-colheita, cumprindo assim com a sua missão e objetivos maiores que são disponibilizar o produto no local desejado, otimizar os processos produtivos e movimentar a economia no agronegócio.

Palavra-chave: logística, pós-colheita, cooperativa.

ARENA SOFTWARE USED IN THE LOGISTICS STUDY OF INTERNAL TRUCK FLOW IN GRAIN PROCESSING UNITS

ABSTRACT: The logistical analysis of production processes supports decision making, predicting future market demand. For cooperatives, this study is important to be prepared for the next harvests, thus serving customers efficiently, especially at the peak of the harvest; where time saving is essential to increase profits and ensure market competitiveness. This effectiveness will also help the producer to be able to follow the planting plans, optimizing their harvests. The objective of this study was to analyze the internal logistic flow of service, using the ARENA software to simulate and verify the current conditions of the grain processing cooperative, in order to find its weaknesses. With the advances of this study and similar ones, the contribution in an incisive way in the strengthening of the logistic improvement and greater competitiveness of the cooperative's business can open the eyes to investment in research in this very important area present in the post-harvest, thus fulfilling its mission. and bigger goals that are, to make the product available in the desired location, to optimize the productive processes and to move the economy in the agribusiness.

Keywords: logistics, post-harvest, cooperative.

1 INTRODUCTION

Brazil is an international leader in agribusiness production, but its logistics infrastructure is one of the greatest obstacles to agribusiness development, which is directly connected to the most widely used mode of transport in the country: road transport (SOUZA, 2019).

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As a fundamental component, transportation is indispensable for maintaining any production chain. For example, companies that acquire commodities or market their products need to transport these items to a distribution center, warehouse, or point of sale at some point in the production chain (SANTOS et al., 2018).

Production systems, as well as agro-industrial systems, have developed through interconnected networks of operations, thus establishing relationships from manufacturing to final consumption, the circulation of which depends on logistics services (SANTOS, PEREIRA; 2019).

With the improvement of production processes, logistics seeks to add value to products. In cooperatives, as in other organizations, logistics is involved and is fundamental for these organizations to be able to meet and satisfy the needs of their customers (COGO, BÜTTENBENDER, 2019).

Production processes individually contribute to the final result, and their capacity can be defined by their ability to meet customer expectations, which is important because of the strong correlation with an organization's profitability (DOMENECH, 2016).

Optimizing production processes is essential since demand and requirements are variable, requiring a survey of studies to identify the processes that cause queues and aiming to reduce both lost time and the resulting damage, both of which are exacerbated by waiting (NASCIMENTO, MENDES, MORAIS; 2021).

Simulation provides support in the analysis of production processes. In the area of logistics, its use has grown, with scenarios such as factories, banks, city traffic, etc., where aspects inherent to companies that work with vehicles/transportation can be analyzed (PRADO, 2014).

To conduct studies that contribute to a better understanding of how production processes work, cooperatives should be prepared for future demands.

The objective of this study was to estimate the resource utilization rate of two grain processing units and the number of trucks each can handle daily under their current conditions, with a focus on identifying bottlenecks and suggesting possible internal improvements.

2 MATERIALS AND METHODS

The work was carried out in two grain processing and storage units belonging to the same cooperative, selected on the basis of their structural differences, in the service processes at reception and dispatch, as well as in the types of clients (cooperative members or nonmembers).

The case studies were conducted under field conditions, with the assistance of workers, in both units.

Monitoring of services and data collection took place at the peak of the soybean harvest in the region during the weeks of March 9--14, 2020, and March 16--21, 2020, respectively, in units B and A.

In these units, all stages involved in receiving freshly harvested soybeans and shipping corn from previous harvests were monitored, and the waiting time for each procedure was recorded, namely, initial weighing, waiting for sample analysis, loading/unloading, and final weighing.

The monitoring of soybean and corn movement was carried out *onsite*, identifying each truck upon its arrival at the yard through the gate of each unit, whether the driver belonged to a cooperative or not.

The analyses and monitoring within the units refer to the following procedures:

- Time of entry registration at the unit.
- Weighing
- Load release time
- Time for unloading (receiving)
- Loading time (shipping)
- Final weight (tare)
- Departure time

Like most simulation software, ARENA visualizes the system to be modeled as consisting of a set of workstations containing one or more resources that provide services to clients who move through the system (PRADO, 2014).

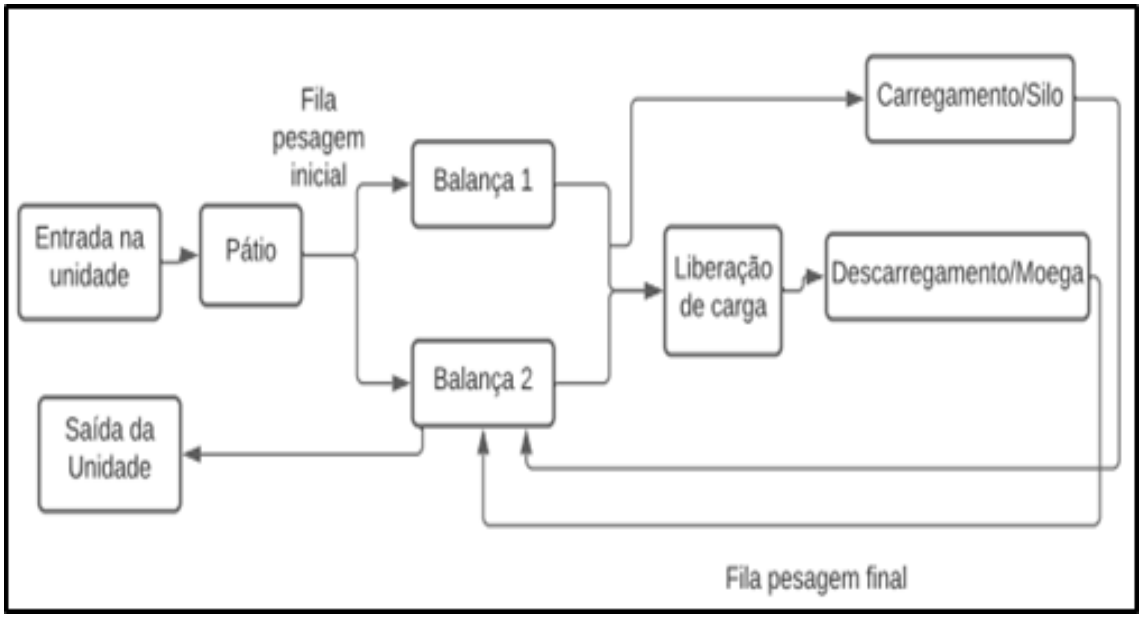
In the ARENA software, the simulation used was the triangular distribution, which uses the minimum time, maximum time, and mode as a basis to generate queue calculations, where 10 hours of daily work were considered, taking into account different shifts and overtime.

The modules used in both units were as follows:

- Create: Creation of circular entities in the system, which were the trucks.
- Process: Processing stations, which include initial weighing, load release and unloading, initial weighing, loading and final weighing.
- Decide: Module designed for separating entities according to preestablished service criteria (loading/unloading).
- Dispose: Module intended for the exit of entities from the system.

Each unit has its own particularities, ranging from the type of customer to its service method, which can be seen in Figures 1 and 2.

Figure 1. Flowchart of the service observed in Unit A

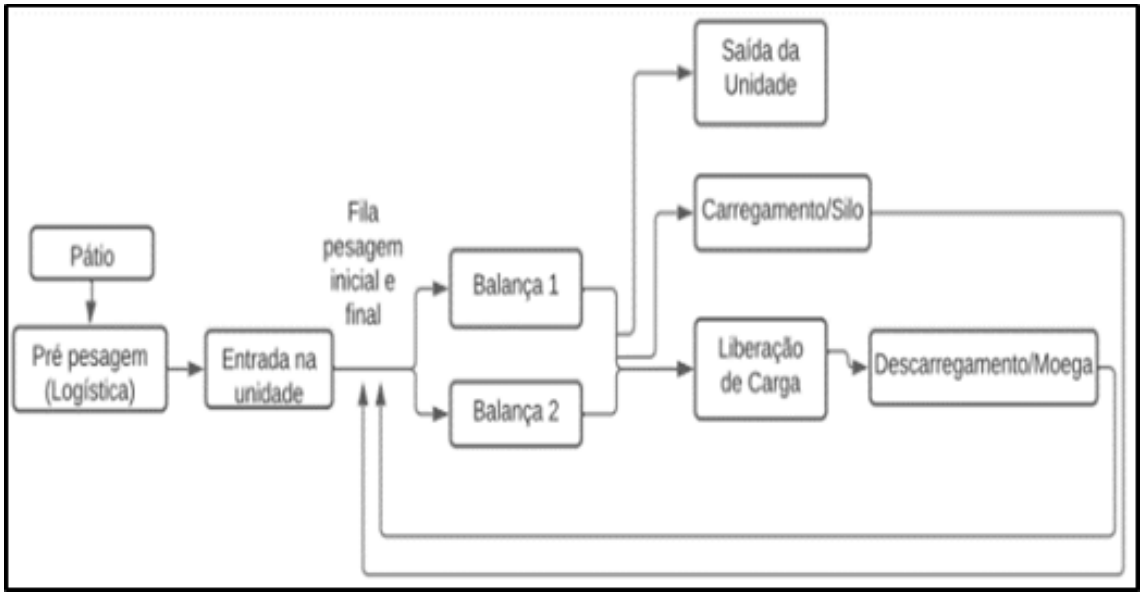


Source: Estimated by the authors (2020)

The specific characteristics of this unit are as follows:

- Patio located inside the unit.
- Its layout allows for prioritization of the truck during weighing.
- Most trucks are grain carriers, as they are mostly outsourced and transport other types of products, such as fruit.

Figure 2. Flowchart of the service observed in Unit B



Source: Estimated by the authors (2020)

The specific characteristics of this unit are as follows:

- It serves more members.
- Most of the trucks served are dump trucks.
- The yard is located outside the cooperative.
- This unit has a preweighing or logistics sector that places the truck in the queue and checks the truck and/or cargo documents.

3 RESULTS AND DISCUSSION

Arena software makes it possible to map and simulate queues in production processes. It serves as support for both startups and established companies, as it allows them to track service times and identify existing bottlenecks.

We can reproduce the service flow scheme, whether fictitiously or real. This software allows the user to elaborate each service step, which will include the times and resources used, be they employees and/or machines.

For the analysis, times provided by the company's registration system and times collected *onsite were used.*

In both units, the service flowchart included entry, initial weighing, separation between loading or unloading, cargo release, final weighing, and exit.

On the basis of the service flow carried out in the units, the following number of modules shown in Table 1 was used, representing the sectors studied in both units.

Table 1. ARENA Modules

Arena Module	Amount
Create	1
Process	5
Decide	1
Dispose	1

Source: Estimated by the authors (2020)

The replication parameters were configured to simulate the processes over 10 hours of daily work.

Considering the optimal service time under suitable conditions, generating the minimum possible queue, in Table 2, we can observe that unit A could serve up to 52 trucks per day and that unit B could serve 81.

These times were obtained on the basis of the collection times.

Table 2. Trucks serviced daily

Units	Number In	Number Out
THE	72	52
B	121	81

Source: Estimated by the authors (2020)

We can highlight that the average number of trucks entering the unit (Number In) exceeds its average service capacity (Number Out), thus showing that the production processes have points that should be investigated to adjust service to demand.

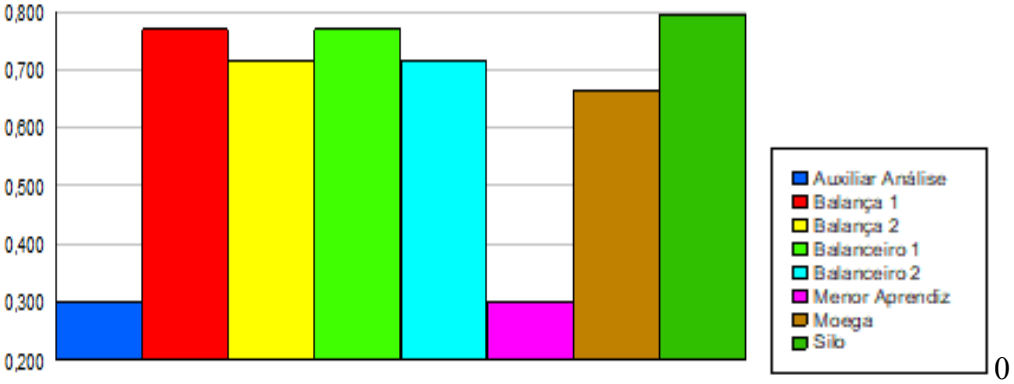
It can also contribute to preparing for future demands if the study is conducted annually, allowing for comparisons with other harvests, where it will be possible to measure the annual growth rate.

Like production processes, resources can also be evaluated; according to their use, we can verify what is used most and least; these can be machines or labor.

By understanding resource utilization, we can determine the investment needs in each area, whether it is necessary to increase, decrease, or reallocate these resources. This information contributes to decisions related to staffing levels and the purchase of machinery/technology, making resource investments more effective.

Figures 3 and 4 allow us to analyze the resources in both units.

Figure 3. Unit A resources

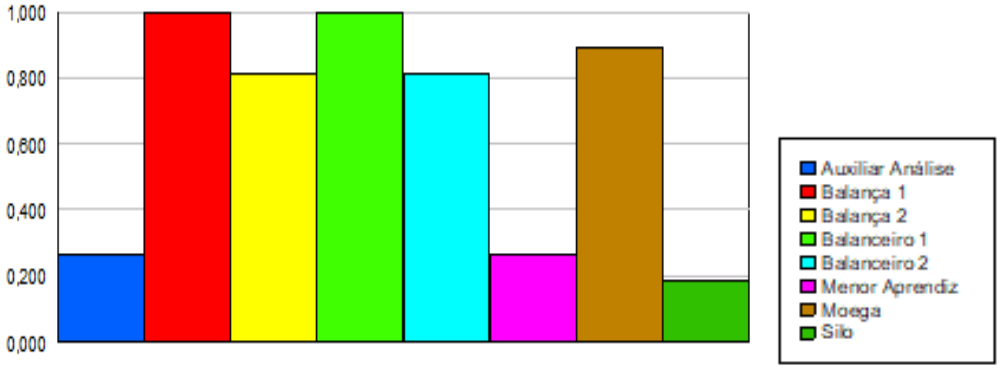


Source: Estimates by the authors (2020)

Table 3 shows the silo as the most frequently used resource, indicating a high sales (shipping) flow at this unit. This is also because the load is empirically estimated by the employee on the basis of their experience, and most of the time, the truck returns to the silo for load correction. Acquiring a flow scale would help alleviate this queue, as the truck would leave the silo with the correct amount of cargo.

The analysis assistant and the junior apprentice were the least used resources because purchasing (receiving) was lower than sales (shipping).

Figure 4. Unit B resources



Source: Estimated by the authors (2020)

In the table, Scale 1 and Weighbridge Operator 1 are the most used resources; in this unit, the number of purchases (reception) was high because the producers in that region were harvesting many soybeans.

Hiring another weightbridge operator would alleviate this overload, as would prioritizing the weighing process by dividing the initial and final weights onto different scales. In this case, scale 1 handles both the initial and final weights, whereas scale 2 handles only the initial weight, thus increasing the utilization of scale 1.

The silo was the least used, as its sales (shipping) rate was low.

Notably, in both analyses, this can vary depending on the time of year.

To make it more efficient, ideally, this study should be reapplied every six months to evaluate resource utilization annually.

4 CONCLUSIONS

The results obtained in this work allowed us to conclude that this study contributes to the preparation and forecasting of future demand, enabling the cooperative to adopt the necessary measures to achieve success and ensure competitiveness in the marketing of grains, retaining existing customers and attracting new ones.

Each unit has its own particularities; therefore, the study can be applied to various cooperatives. They must be analyzed individually because the results obtained differ.

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