

Role-Based Constraints in Forestry Machine Operator Training: A Bottleneck Analysis of Training Technicians in a Pulp Company

Ezzeldin Mohamad Mahmoudhussein

Graduated in Production Engineering, Federal University of Mato Grosso do Sul, Três Lagoas - Mato Grosso do Sul, Brazil
ezzeldin.mohamad@ufms.br

Abstract: *Given the continuous transformations in the global landscape, human resource training and development have become a valuable strategic investment for large organizations. In the cellulose sector, forestry operations rely on training technicians responsible for the development and improvement of machine operators, with performance objectives that necessitate close monitoring of their daily routines. This study conducts a case study aimed at identifying time-related bottlenecks in the routine of a training technician at a selected company and proposes targeted improvements. Based on a temporal analysis of the technician's activities, time bottlenecks were mapped. Using quality management tools—including an affinity diagram, prioritization matrix, and decision-making process diagram—the main root causes were identified, and a priority order for time-saving interventions was established. The proposed solution involves the development of a mobile application for conducting Technical Evaluations (ET) in the field, complemented by a visualization dashboard. Finally, the implementation plan is structured using the 5W2H and PDCA tools, providing a practical pathway for the company to reduce or eliminate the identified bottleneck.*

Keywords: Machine Operator Training; Bottleneck Analysis; Forestry.

1. INTRODUCTION

To achieve success, organizations need to have talented, perceptive, agile individuals with an entrepreneurial spirit and a willingness to take risks. These professionals are responsible for driving businesses, developing products, and providing exceptional services. To achieve this level of performance, adequate training and preparation are essential. The most successful organizations invest significantly in training, viewing it not as a cost but as a strategic investment, both for the development of the company itself and its employees (Chiavenato, 2014).

Nascimento (2001) highlights the importance of training in the cellulose industry by addressing the return on investment in training due to the competitiveness and globalization of its businesses, the increased demand for technical updating, and the need for results-based management.

According to the Brazilian Technical Association of Cellulose and Paper (ABTCP), the cellulose and paper sector consists of 220 companies operating in 540 municipalities across 18 Brazilian states, generating 128,000 direct jobs and 640,000 indirect jobs. According to the 2022 annual report of the Brazilian Tree Industry Association (IBA), among the top ten cellulose exporters, Brazil remained the world's largest in 2021, having exported US\$6.7 billion, approximately US\$1.9 billion more than the second-place country.

Considering that wood is the raw material for cellulose and paper production, forestry sector management is fundamental to the success of operations. Forest harvesting is a complex process involving multiple stages, being challenging, time-consuming, and high-cost. Three main phases stand out: cutting and processing, extraction, and transportation. Among these, the extraction operation, which involves skidding or dragging wood from the cutting site to the roadside (landing), is considered one of the most costly stages of the process (Malinovski et al., 2008).

With emphasis on the cutting and bucking stages, their execution can be mechanized, making the operational efficiency of machine operators essential. Parise and Malinovski (2002, cited in Lopes, 2008) state that in forestry companies, there is a high number of high-tech wood harvesting machines and equipment that increasingly require skilled operators. Furthermore, according to the author, the shortage of these operators has caused significant damage to the machines, compromising work productivity and quality, increasing production costs, and having environmental impacts.

According to Lopes (2010), one way to improve operational efficiency is by training operators through the

provision of training programs, enabling them to use forestry machines to their maximum capacity.

Thus, aiming to maximize productivity and quality, the development of techniques and training programs are essential to improve the performance of machines and operators. In this context, the company that is the subject of this study has a position called training technician, whose role is to train new operators and enhance experienced ones, in order to boost productivity and quality, minimizing possible operational errors and machine damage. In the routine of these technicians, every minute spent is important, as the more time they spend training operation students and/or operators, the more the latter will improve, both in terms of productivity and quality.

Given the above, the main objective of this work is to identify possible time bottlenecks in the routine of training technicians at a pulp sector company. To achieve this objective, through a case study, a previously conducted time analysis of the technicians at the company will be used to better understand their routine. To complement this analysis and identify the main bottlenecks and their root causes, some quality management tools will be employed, such as the affinity diagram, prioritization matrix, and decision process diagram (Carpinetti, 2012; Lobo, 2020). Finally, PDCA (Plan, Do, Check and Act) and 5W2H (What, Why, Where, Who, When, How and How Much) will be applied as guides for improvement proposals.

2. THEORETICAL FRAMEWORK

2.1 Affinity Diagram

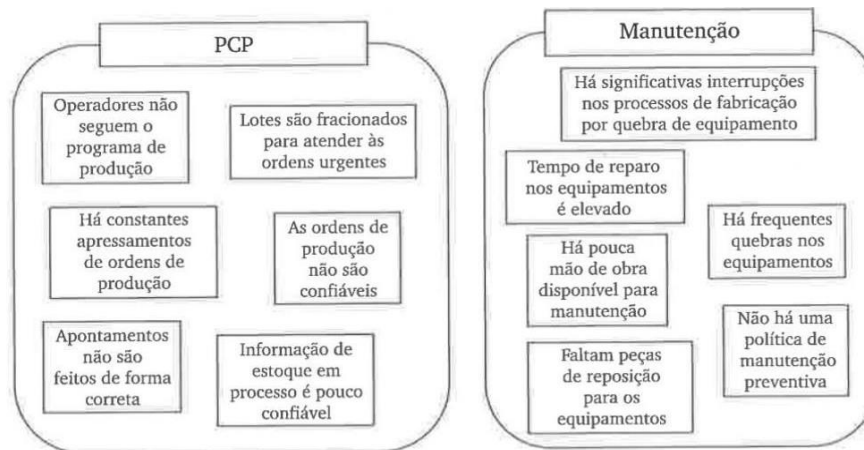


Figure 1: Example affinity diagram.

According to Carpinetti (2012), the purpose of the affinity diagram is to group similar ideas related to the topic, thereby eliminating redundancies, identifying gaps in the idea-gathering process, and consequently better understanding a phenomenon. Figure 1 shows how this grouping of ideas works using the Production Planning and Control (PCP) and Maintenance groups as examples.

According to Almeida et al. (2006), the idea of the Affinity Diagram converges with teamwork, as the problem of organizing ideas arises when multiple people express their views on the same topic. The grouping process is slow because it is necessary to capture the essence of each idea in each piece of data. Therefore, it is advisable to be certain that the topic is suitable for this type of work.

2.2 Prioritization Matrix

The prioritization matrix, as the name suggests, relates factors to priority criteria. It can prioritize a list of improvement actions based on criteria such as reducing internal costs and improving customer satisfaction, or it can establish priorities to eliminate or minimize a product problem or defect based on scores assigned to criteria such as severity, occurrence, and detection of defects (Carpinetti, 2012).

According to Daychoum (2007), the GUT prioritization matrix is a way to address problems with the aim of prioritizing them. It gets this name because it takes into account gravity (G), which shows the impact of the problem on things, people, results, processes, or organizations and the consequences that will arise in the long term if not resolved; urgency (U), which aims to present the relationship with the available or necessary time to solve

the problem; and trend (T), which shows the problem's growth potential by assessing the tendency for the problem to grow, decrease, or disappear. For each of these groups (gravity, urgency, and trend), a score from 1 to 5 is assigned to a specific problem or group of problems. The scores for each problem and/or group of problems are multiplied, and the one with the highest value should be prioritized.

Still following Daychoum's (2007) idea, Table 1 illustrates when each score should be assigned to one of the groups (gravity, urgency, and trend), in addition to presenting how the multiplication works, which ultimately determines what should be prioritized.

Table 1: GUT Prioritization Matrix.

NOTE	SEVERITY (G) CONSEQUENCES IF NOTHING IS DONE	URGENCY (U) TIMEFRAME FOR DECISION-MAKING	TREND (T) PROPORTION OF THE PROBLEM IN THE FUTURE	G x U x T
5	The losses or difficulties are extremely severe	Immediate action is required	If nothing is done, the situation will worsen immediately	5x5x5=125
4	Very severe	With some urgency	Will worsen in the short term	4x4x4=64
3	Severe	As soon as possible	Will worsen in the medium term	3x3x3=27
2	Slightly severe	Can wait a little	Will worsen in the long term	2x2x2=8
1	No severity	No hurry	Will not worsen or may even improve	1x1x1=1

Source: Daychoum, 2007.

2.3 Decision Process Diagram

According to Carpinetti (2012), the decision process diagram is a tool that seeks to systematize the decision-making process, illustrating through a tree diagram the chain between the decisions made and the consequences or outcomes of these decisions. The decisions may refer to explanations for a problem being analyzed, or they may refer to actions to achieve a specific objective. The decision results from an analysis process, in which alternatives are identified and analyzed regarding their viability and effectiveness or probability of occurrence. In Figure 2, there is an illustration showing concisely how a decision process diagram works.



Figure 2: Example of a decision process diagram.

2.4 PDCA

The PDCA cycle or continuous improvement cycle aims to identify and organize the activities of a problem-solving process in order to effectively ensure the development of a planned activity. Unordered growth, combined with a lack of planning and goal definition, causes the company to not have a solid foundation and to go through seasonal situations; the correct use of this tool allows the company to grow always with a solid foundation, promoting continuous process improvement (Lobo, 2020).

According to Gayer (2020), the PDCA cycle has four stages: P (plan): consists of clearly defining objectives and goals, as well as choosing the method to be used to achieve what was proposed; D (do): corresponds to the execution of the previously established plan, focusing on meeting the determined objectives and goals; C (check): involves analyzing the data collected after the implementation of the planning, with the aim of evaluating the results; and A (act): after analyzing the data, it is necessary to check if the objectives were achieved. If not, it is necessary to review the objectives and methods used, as well as restructure the planning as needed.

In Figure 3, a PDCA cycle model can be observed showing the division of the four presented stages.

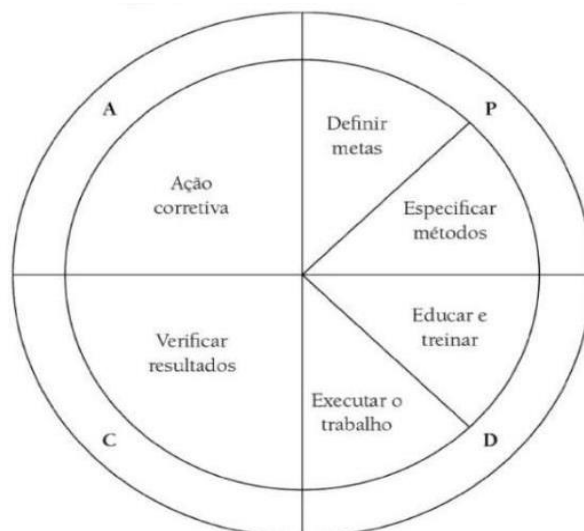


Figure 3: Phases of the PDCA Cycle.

Due to its cyclical nature, the PDCA cycle, as it is applied, increases the probability of identifying new problems that may affect the quality of the final product. Its iterative four-stage approach aims to continuously improve processes, products, or services and problem-solving (Gayer, 2020; Lobo, 2019).

2.5 5W2H

Daychown (2007) describes the 5W2H as a tool that basically consists of asking questions in order to obtain the essential information that will serve as support for planning in a general way, thus being a practical tool that allows, at any time, knowing the most important data of a project.

The 5W2H is based on seven essential questions which are (Carpinetti, 2016):

- a) what: brief description of the action to be executed;
- b) why: justification for executing the action;
- c) where: location, unit, or process where the action will be carried out;
- d) who: definition of the person responsible for executing the action;
- e) when (quando): scheduled dates for the start and end of the action;
- f) how (como): brief explanation of the action's implementation method;
- g) how much (custo): specification of the costs associated with the action.

The 5W2H tool is commonly used for the implementation and monitoring of improvement actions, serving as a practical and effective method for planning and monitoring processes (Carpinetti, 2016).

3. METHODOLOGY

Considering the objectives stated for this work, it can be classified by purpose as exploratory, as it seeks to provide greater familiarity with a problem by analyzing the routine of the training technicians at the studied company, in order to identify possible bottlenecks and subsequently propose improvement ideas to optimize their routine. In terms of nature, this research is classified as applied, since its purpose is to generate knowledge through practical application aimed at solving a specific problem (Prodanov; Freitas, 2013). As for the approach, it is qualitative, as it is characterized by the relevance of the researcher's interpretation, based on subjectivity (Gil, 2002).

Based on the previous classifications, the method adopted was the case study, which was conducted in a pulp company, considering its forestry operations. The company's name was omitted for confidentiality reasons.

The problem investigated by this research is related to the position of training technician, whose role is to train new operators (not yet hired) and train experienced operators (already hired). The aim is to identify possible bottlenecks in the routine of these technicians, so that the training provided by them can be expanded or even improved.

For this, a time analysis of the routine of these technicians, carried out in a previous study at the company in question, was used. Free access was granted to the study (data tabulated in Excel spreadsheets), making it possible to gather information regarding the main activities performed by the twelve training technicians considered. To identify the main bottlenecks, meetings were held between January and February 2024 with the supervisor and coordinator of the area. The supervisor is the immediate manager of the training technicians and is responsible for managing all training and development of forest harvesting operators, and the coordinator is the immediate manager of the supervisor and responsible for training and development across the entire forestry area.

After identifying the main bottlenecks, quality management tools were applied to better understand the problems found and identify the main root cause. A possible proposal to eliminate or minimize the selected bottleneck was also presented.

4. RESULTS AND DISCUSSIONS

The present study was developed in the forestry sector of a pulp company. During the study period, the company had not yet started industrial operations, but forestry operations were already underway. The operations involving forest harvesting are carried out by this company in a mechanized manner, with emphasis on harvester machines, which are felling, delimiting, bucking, and stacking tractors, and forwarders, which are forestry tractors used for primary transportation through self-loading/unloading (Linhares et al., 2012).

Considering the company's implementation phase, the start of operations related to forest harvesting would require the hiring of specialized labor (forest machine operators and mechanics) from other locations, increasing costs or even making hiring difficult due to a lack of available professionals. In this way, the company chose to adopt a training program for these roles.

In this sense, there is the role of the training technician, who is responsible for training and improving operators, first teaching them in simulators and later in forestry machines (harvester and forwarder). During the training phase, the operators are divided into four groups of twenty students, and each group has two technicians. After completing the training course for a class, the top students/operators are hired and assigned to a harvesting module, and a technician is assigned to monitor and improve these already hired operators, along with experienced operators hired previously.

The study in question addresses the work carried out by training technicians both in the training of operators and in the improvement of already hired operators, seeking to identify possible time bottlenecks in their routine. During the study period, the company had a total of twelve technicians, with eight assigned to training and four to improvement.

To understand the routine of these technicians, meetings were held with the area supervisor, who listed and described the main activities they perform. These activities can be seen in Table 2.

Table 2: Main activities performed by the training technician in the studied company.

ACTIVITIES	DESCRIPTION
Technical Evaluation (AT)	Evaluation tool for operators/students in which they are assessed for 30 minutes on productivity, operational technique, and operational quality
Assisting student/operator	Period in which the technician shows the operator/student their improvement points and explains how to improve in that area
Quality evaluation	Evaluation focused exclusively on assessing the quality of the student/operator and verifying if they are delivering a product good enough to be taken to the factory (correct length, good peeling, maximizing wood usage, among other factors)
Safety training	Period in which the technician explains or teaches something related to safety, for example: use of PPE, showing where the machine's emergency exits are, how to operate near electrical wiring, among others
Other trainings	Period in which the technician teaches the student/operator something not related to the previous trainings, for example teaching about machine operation, how to change cutting material, among others
Walking movement	Period in which the technician is moving on foot (moving from one machine to another, from the module base to a machine and vice versa)
Car movement	Period in which the technician is moving using a company car (moving from one machine to another, from the module base to a machine and vice versa)
Tabulating AT/Report data	Period in which the technician is tabulating in EXCEL information from the AT collected in the field and the weekly report with all AT information conducted in the last 7 days
Administrative activities	Meetings and alignments with the supervisor that the technician participates in (Not a routine activity)
Other activities	All activities not previously listed, such as lunch time, going to the bathroom, bus delay, among others

These activities must be developed considering some established goals:

- a) conducting two Technical Assessments (TA) per shift;
- b) at least 50% of the technician's routine must be dedicated to training (TA, assisting the student/operator, quality assessment, safety training, and other training), i.e., at least 4 hours dedicated to training per shift, considering that the shift lasts 8 hours (7 hours of work and 1 hour for lunch/break).

To conduct a TA, the technician needs to record all necessary data on a printed Excel form and, at the end of the shift, tabulate this information in an Excel file and send it to the TA database.

In the TA, productivity is measured by the number of trees felled during the assessment multiplied by the average volume of trees at the site, and the percentage relative to the unit's target is checked. For operational technique and operational quality, the technician marks when the student/operator makes mistakes in pre-selected topics, thereby deducting points from them.

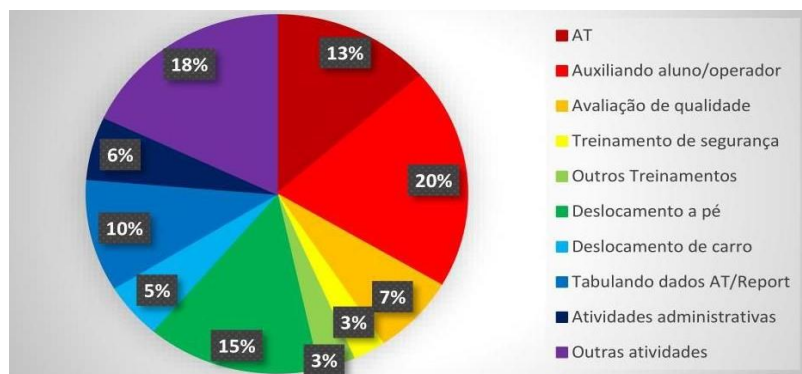
Technicians also need to prepare a weekly report on all activities carried out during the past week, in which they must detail the results obtained in TAs and quality assessments, and if any different training was conducted, add information and photos about it. Once consolidated with information from all technicians, this report is sent to the forest harvesting management positions (Supervisors, Coordinators, and Manager).

4.1 Time Analysis

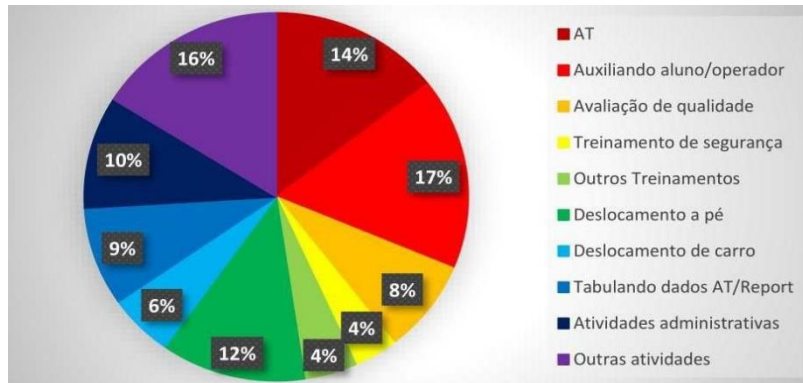
Using the time analysis of the training technicians' routine from a previously conducted study, it was possible to observe the time spent on each of the main activities listed earlier. The data was collected considering three days per technician, during three of their work shifts, where each shift corresponds to eight hours, totaling twenty-four hours of monitoring per technician. In total, assuming twelve employees in this role, there were approximately 288 hours of monitoring.

The routine of technicians focused on student training (eight technicians) and those focused on operator improvement (four technicians) are slightly different; that is, they perform the same activities but dedicate different amounts of time to each. This is because students in the training phase most often have more difficulties and questions about the process than already hired operators.

Thus, for data analysis, the two types of technicians were considered separately. The following Graphs 1 and 2 summarize the collected information, showing the percentage of time spent on each of these main activities.



Graph 1: Hours spent by training technicians assigned to training according to activities



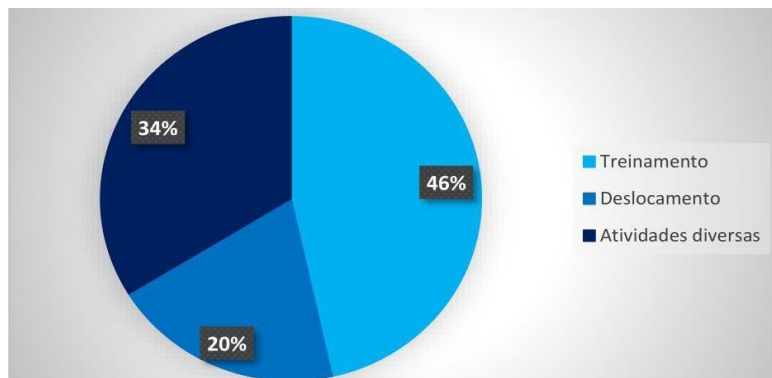
Graph 2: Hours spent by training technicians assigned to improvement according to the activities performed.

It can be noted from Graphs 1 and 2 that the time spent on the technicians' activities (considered in distinct groups) differs mainly in "administrative activities". In fact, technicians focused on improvement actively participate in meetings with the harvesting module management, providing input in specific situations, unlike technicians focused on training, whose participation is sporadic.

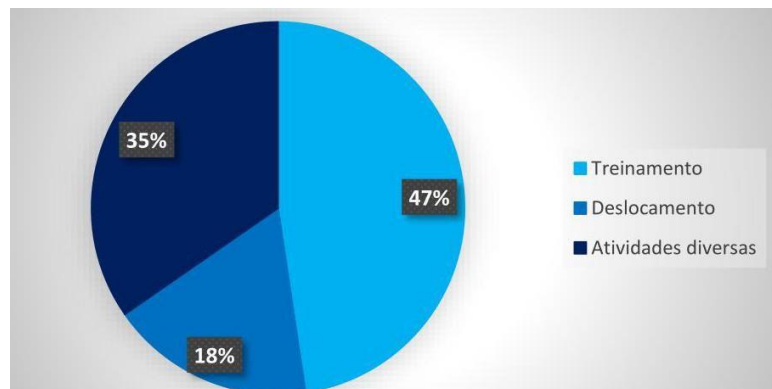
Considering the established goals, it is observed that the goal of conducting two ATs per shift was met throughout the monitored period, with no difficulties noted in meeting it. To improve understanding of the second goal, namely dedicating at least 50% of the routine to training, activities were divided into three groups:

- a) training: AT, assisting student/operator, quality assessment, safety training, and other training;
- b) travel: walking travel and car travel;
- c) miscellaneous activities: AT/Report data tabulation, administrative activities, and other activities.

Charts 3 and 4 illustrate the hours required for each activity group for the two types of technicians studied.



Graph 3: Hours spent by training technicians assigned to training by activity groups.



Graph 4: Hours spent by training technicians assigned to improvement by activity groups

Analyzing both charts (Charts 3 and 4), it can be verified that the technicians did not reach the minimum of 50% of

time dedicated to training activities (both technicians assigned to training and those assigned to improvement). Thus, in order to identify possible bottlenecks in the routines of these technicians, the five activities not related to this goal were analyzed, namely "Walking travel", "Car travel", "AT/Report data tabulation", "Administrative activities", and "Other activities", with the aim of identifying possible existing bottlenecks in the routine of these technicians.

Based on the times and movements observed from the considered data, meetings were held with the team responsible for the sector (supervisor and coordinator), who, with technical knowledge about the role's activities, was able to identify some improvement points listed in Table 3.

Table 3: Bottlenecks identified from the time analysis of training technicians.

ACTIVITY	MAIN CAUSES IDENTIFIED
Tabulating AT/Report data	- Lack of a tool to conduct the assessment directly in the field (without having to do it on paper and then transfer and tabulate the data afterwards); - lack of internet signal, thus delaying the addition of information to the database; - Lack of management of the technician's own routine, causing accumulation of ATs leading to the tabulation of multiple assessments at once.
Travel	- Distance from the module base to the machines; - Lack of a vehicle for the technician; - Lack of creation of a schedule for conducting the AT, as often the technician starts traveling to look for a machine to perform it.
Bus delay (included in other activities)	- Distance from the city to the farm where the module is located.

Once the bottlenecks were identified, a detailed analysis of them was carried out with the aid of quality management tools, aiming to better understand the problem and specify the main root cause, as described in the subsequent sections.

4.2 Application of Quality Management Tools

To eliminate or reduce the identified bottlenecks, an affinity diagram was developed, considering the information presented in the theoretical framework. In meetings with the same previously mentioned team, it was possible to establish groups, dividing the bottlenecks into: tools (bottlenecks caused by the lack of a work tool), organization (caused by the technician's lack of organization), and structure (caused by something related to the workplace), which can be seen in Figure 4.



Fonte: Elaborado pelos autores.

Figure 4: Affinity diagram of the bottlenecks identified in the time analysis.

Considering the three groups defined by the affinity diagram, a GUT prioritization matrix (Table 4) was developed, in accordance with the procedures described in section 2.2 of the theoretical framework, in order to establish which of these groups should be prioritized to work on eliminating or minimizing these bottlenecks.

Table 4: GUT prioritization matrix for the three groups defined from the affinity diagram.

PROBLEMS	G	U	T	GXUXT	PRIORITY
Tools	5	3	3	45	1
Organization	3	2	4	24	3
Structure	5	3	2	30	2

Based on Table 4, using the GUT prioritization matrix, it was possible to observe that the bottlenecks caused by the lack of tools should be prioritized over those caused by the "organization" and "structure" group bottlenecks.

Thus, a decision process diagram was developed (Figure 5) to define the best path to follow in solving the problems caused by the lack of work tools. The collaboration of both the supervisor and the coordinator (the supervisor's immediate manager) was fundamental to being able to arrive at an idea to minimize or eliminate the

bottleneck and already discard ideas considered unfeasible for the company.

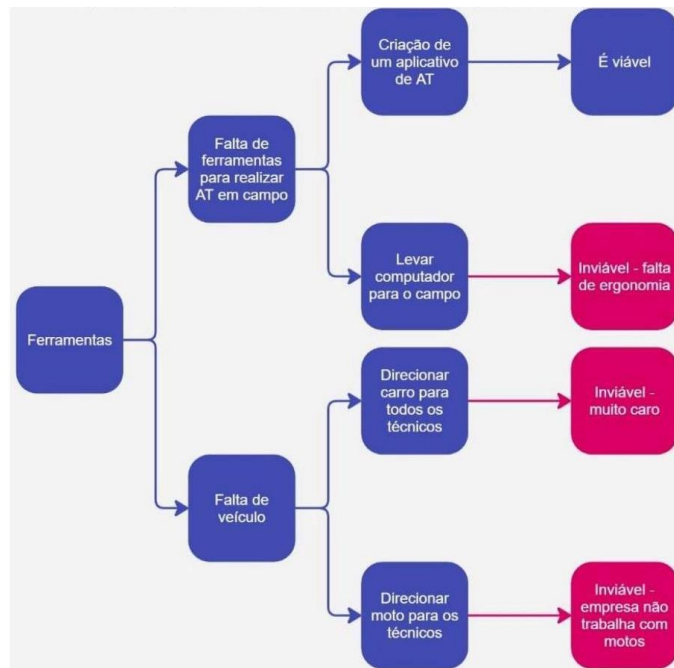


Figure 5: Decision Process Diagram for Tool Group.

Based on the decision process diagram, it was found that the company should first focus on creating an application for implementing the AT offline (without needing a Wi-Fi signal or mobile data), so that the technician can perform the AT with the machines and when they have internet access, they only need to send it to the database, thus not needing to enter this information later, resulting in a significant time saving.

In addition, as the data goes to a common database, the company will be able to create a visualization dashboard where all the information obtained in the AT can be viewed more easily, and thus there will be no need for the report, since the forest harvesting employees can simply access the dashboard and view the information that is relevant to them. This will eliminate all the time spent on tabulating AT data and reporting.

Assuming the company adopts the improvement suggestions described earlier (creation and implementation of an application and implementation of the visualization dashboard), the time saved in the routine of the training technicians, in both functions, training or improvement, would be 10% and 9%, respectively (times collected in the time analysis illustrated in Graphs 1 and 2). Table 1 describes the time spent per activity group, considering the scenario before and after the possible implementation.

Table 1: Hours spent by technicians training forest machine operators before and after the possible implementation of the suggested improvement.

TECHNICIAN TYPE	ACTIVITY GROUP	HOURS SPENT BEFORE	HOURS SPENT AFTER
TRAINING	Training	89,33 (46%)	89,33 (52%)
	Travel	37,87 (20%)	37,87 (22%)
	Miscellaneous activities	64,80 (34%)	45,47 (26%)
IMPROVEMENT	Training	45,73 (47%)	45,73% (52%)
	Travel	17,00 (18%)	17,00 (19%)
	Miscellaneous activities	33,27 (35%)	24,93 (29%)

Based on the data in Table 1, it is observed that by creating the AT app and eliminating the need to tabulate AT data and the weekly report, the technicians assigned to training previously spent 46% of their time on training, and those assigned to improvement 47%; after this scenario, both would spend 52%, meeting their target. In the time analysis, the twelve technicians spent a total of 27 hours and 40 minutes solely on this eliminated task. Since each technician was monitored for three days, there were 36 monitoring days, meaning the technicians spent an average of 46 minutes per day on this task. Considering that a technician works 22 days a month, each technician would have an average monthly time savings of 16 hours and 52 minutes, resulting in a total savings of 202 hours and 24

minutes (just over eight days).

Once the best solution to reduce bottlenecks in the function of the studied technicians was defined, the PDCA and 5W2H tools were applied to demonstrate how the company could proceed with their implementation.

First, a PDCA cycle was developed to identify and organize the activities related to the implementation of the suggested improvements. Figure 6 describes the four phases developed, considering the content presented in section 2.4.

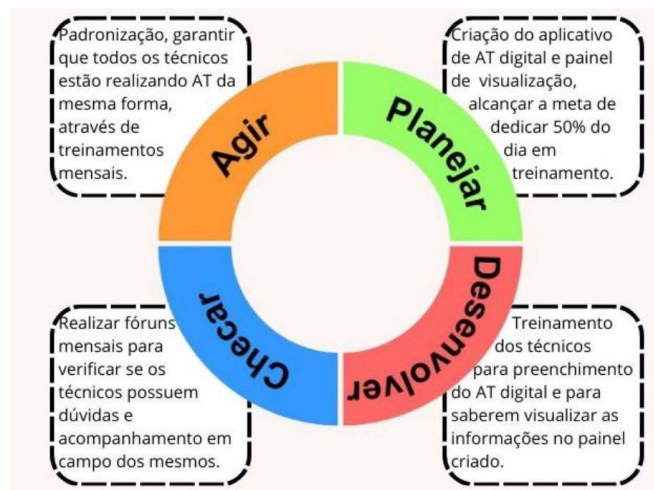


Figure 6: PDCA Cycle for Implementing Suggested Improvements in Reducing Identified Bottlenecks

With the described PDCA cycle, the sequence of steps to be followed by the company can be verified, organizing and reducing the risks of possible errors in the adoption of the two presented suggestions.

Additionally, with the aim of highlighting the action plan in the development of the app for AT, the 5W2H tool was used. Table 5 summarizes this result.

Table 5: 5W2H Tool for Structuring the Development of the AT App.

5W					2H	
O que? (What?)	Porque? (Why?)	Onde? (Where?)	Quem? (Who?)	Quando (When?)	Como? (How?)	Quanto? (How Much?)
Criação de aplicativo para a AT	Otimizar o tempo do técnico de treinamento	Setor de tecnologia	Analista de tecnologia-Colheita	05/09/2024	O analista irá programar um aplicativo no formato atual da AT	R\$50000,00
5W					2H	
What? (What?)	Why? (Why?)	Where? (Where?)	Who? (Who?)	When (When?)	How? (How?)	How much? (How Much?)
App creation for AT	Optimize the training technician's time	Technology sector	Technology Analyst-Harvest	05/09/2024	The analyst will program an app in AT's current format	R\$50000,00

Thus, it can be observed that the implementation of the mentioned application would require an investment of approximately 50 thousand reais. This cost refers to software usage licenses (considering one license per technician). The company's existing technology sector, through the technology analyst from the harvesting sector, would program the necessary steps to carry out an AT in software (development of an application). This software is already used by the company for other functions and can be adapted free of charge. However, to ensure the confidentiality of the collected information, it must be used in a paid version, which is the cost mentioned.

5. CONCLUSION

This article presented a case study in the forestry sector of a cellulose industry, aiming to identify possible bottlenecks in the routine of the training technician for forest machine operators. For this purpose, a time analysis of these technicians' routine, conducted previously, was used, and with the aid of quality management tools, it was possible to specify the main root cause and suggest an improvement proposal.

The study was conducted considering a total of twelve technicians, eight of whom performed the training function and four the improvement function. Both functions had the main goal of dedicating at least 50% of their time to activities in the group called "training", and non-compliance with this was verified through time analysis.

With the aid of an affinity diagram and a GUT prioritization matrix, it was observed that the bottleneck specified as "tools" should be prioritized. Then, a decision process diagram was developed, leading to the conclusion that to achieve time savings, it would be necessary to implement an application for performing the AT activity and a visualization dashboard, thus eliminating the need for the "Tabulating AT data/Report" activity.

The implementation of these improvements would lead to a time saving in the routine of the studied technicians of approximately 10% and 9% in the training and improvement functions, respectively, thus complying with the specified main goal.

Finally, considering the possibility of implementing the suggested application and the visualization dashboard, a PDCA cycle was presented so that the company can understand the steps to be followed in the pursuit of improving the process in question. The 5W2H tool was used to structure the development of the AT application, showing that, through the company's technology sector, the technology analyst from the harvesting sector would program the application, with an investment being necessary if the company decides to keep the data confidential.

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