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Proposal for improvement of analysis and solution of industrial problems based on pdca and quality tools

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ABSTRACT
In today's market, companies are increasingly looking for ways to monitor and analyze their production processes in order to help solve problems that often seem impossible to solve, causing huge financial losses for companies.

Keywords: Continuous improvement, Industrial problems, PDCA.

INTRODUCTION

In the current market in any segment of work, daily optimization in their production processes is increasingly sought, that is, companies have been looking for ways of monitoring and analysis capable of helping to solve problems that often seem impossible to solve, causing enormous financial losses to companies.

Faced with this reality, the search for the elimination of waste in production occupies a very important role within the company, in order to achieve better productivity, not wasting capital with defective parts, producing only what is necessary and obtaining gains in the flow of processes and materials, eliminating other lost times that generate productivity losses. All this analysis must be structured with appropriate tools in order to identify the possible causes of the problems that are generating waste in the production processes.

One of the most efficient approaches to combat losses is the Methodology for Analysis and Problem Solving (MASP), which was developed based on the philosophy of continuous improvement, with the objective of eliminating the recurrence of anomalies and ensuring an increase in the quality and performance of processes (CAMPOS, 2004).

The use of MASP implies the adoption of analytical tools that measure, analyze and suggest actions against losses that interfere with business performance. These tools are known as Quality Tools and are applied in continuous improvement processes to eliminate process anomalies, providing an increase in quality and performance of organizational results (TUBINO, 2009).

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In addition, it involves the participation of a group of qualified people to make decisions, following a logical and rational sequence. This sequence should follow the following 8 steps: observation, analysis, action planning, action, verification, standardization, and conclusion (ARIOLI, 1998; FERREIRA, 2010).

OBJECTIVE

In this sense, the tool proposed in this work is intended to assist in the solution of problems. One of the premises is to provide a simplified and easy-to-use tool, aimed at dealing with problems that interfere with the productive activities of companies. The method that will be proposed is developed based on the PDCA continuous improvement methodology, being operationalized by the quality tools and developed in three stages, namely: Identification, Analysis and Action.

The work adopts theoretical study as a methodological approach. For data collection and adaptation of the proposed method, the study of bibliographic researches, such as scientific articles, books and websites, was used. To fulfill its objectives, the work first establishes the theoretical framework, followed by the methodological procedures adopted, expected results and, finally, its conclusions.

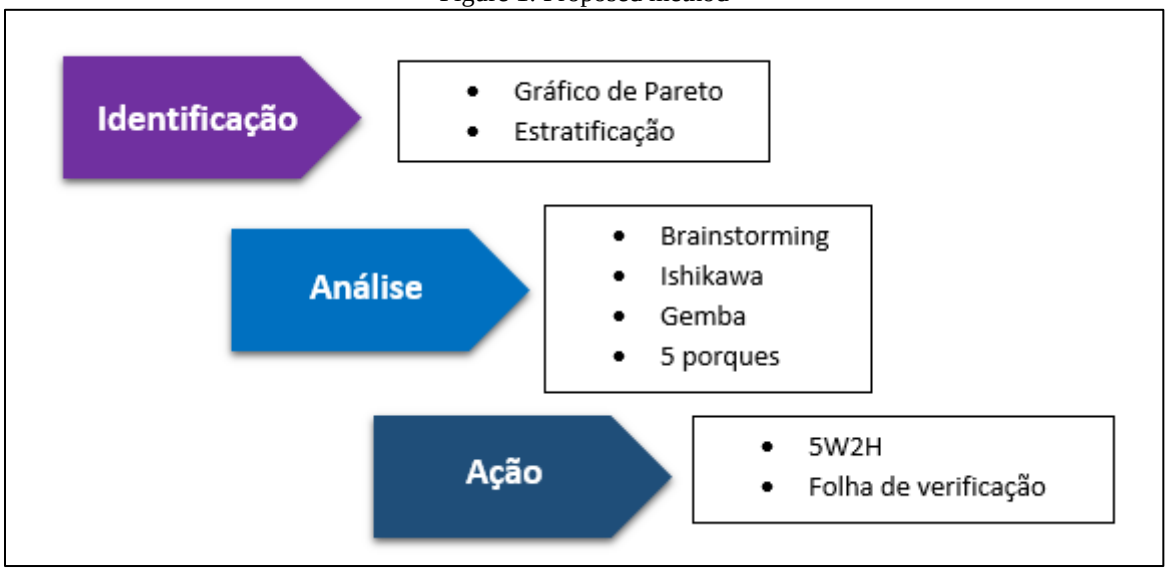
METHODOLOGY

The research was based on the study with the objective of proposing the use of a simplified methodology of problem solving in industries based on the methodology of MASP with the aid of quality tools. The proposal was made in a targeted way for small to medium-sized industries. To substantiate the theoretical references in the research, sources of articles published in journals and websites were cited. The data collected was based on the MASP methodology and academic articles containing case studies.

The proposed method consists of three easy-to-apply steps, based on the PDCA methodology. One of the main barriers found in the implementation of the method is the employee motivation factor, due to the excessive formalism and filling out of the methodology's documents, creating resistance to change by employees and obstacles in learning and difficulty in discernment.

Next, the three steps of the proposed method will be detailed, 1 - Identification, 2 - Analysis and 3 - Action, represented in figure 1.

Figure 1: Proposed method



Source: Prepared by the author (2019)

DEVELOPMENT

In this topic, the concept of PDCA and MASP will be addressed, methodologies on which the proposed method was based, and concepts of quality tools, such as Pareto, Stratification, Brainstorming, Ishikawa, Gemba, "5 Whys" and 5W2H.

CONTINUOUS IMPROVEMENT

Continuous improvement is based on the idea that any activity and result can always be improved. Continuous improvement programs can occur both from the bottom up and from the top down in the organizational chart, where employees are encouraged to examine and recommend changes in the work processes in which they participate, and for senior management to align them strategically, otherwise continuous improvement activities tend to become an isolated event (PIECHNICKI, 2014).

PDCA

The methodology proposed for this research is based on the PDCA continuous improvement cycle. It is a quality tool that aims to facilitate decision-making and achieve goals, focusing on the continuous improvement of an operating system in the company, in order to ensure the survival of the organization. Although simple, it represents a major step forward for effective planning.

According to Werkema (1995), the acronym is formed by the initials:

P (Plan) – Plan: establish the objectives and processes necessary to deliver results according to predetermined requirements and policies;

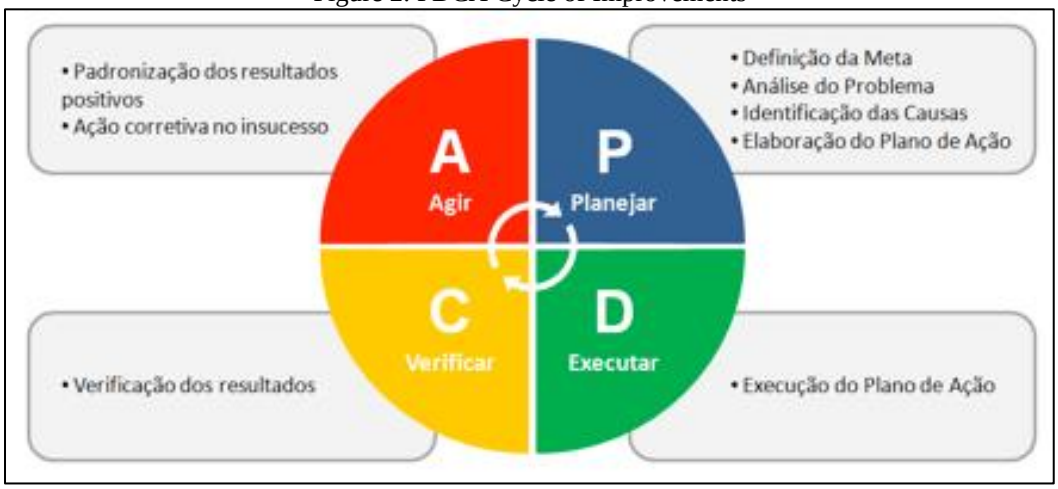
D (Do) – Do, execute: implement the necessary actions;

C (Check) – Check, verify: monitor and measure processes and products in relation to established policies, objectives and requirements and report on results;

A (Act) – Act: Perform actions to continuously promote process improvement.

After the results are achieved, they are questioned in order to verify if the defined objectives have been achieved, if not, the cycle is restarted as many times as necessary until the expected results are achieved, as shown in figure 2.

Figure 2: PDCA Cycle of Improvements



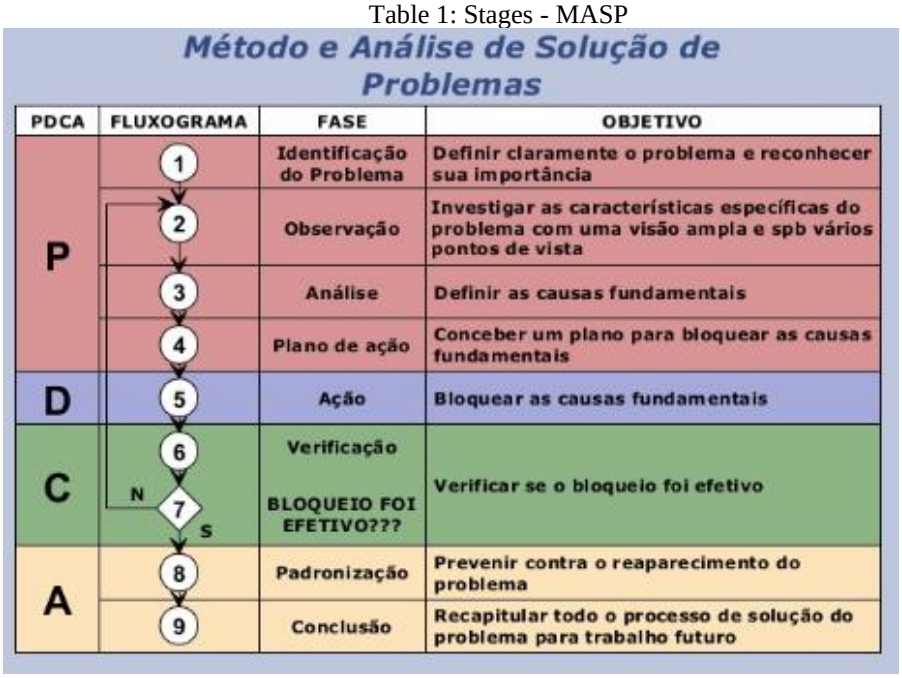
Fonte: http://www.ccprleite.com.br/media/4071/graf1novjpg.aspx

METHODOLOGY OF ANALYSIS AND PROBLEM SOLVING (MASP)

It is a systematic method consisting of 8 steps, fed with data and information with the aim of discovering the real cause of the problems that arise in the production processes and proposing solutions to combat and eliminate losses.

These problems are identified, treated, and improved through 8 sequential steps: 1-Identification; 2-Observation; 3- Analysis; 4- Action Plan; 5- Action; 6- Verification; 7- Standardization; 8- Conclusion, as shown in chart 1.

Table 1: Stages - MASP



Fonte: https://www.researchgate.net/figure/Figura-1-MASP-e-PDCA-Fonte-Campos-1992_fig3_314554148

Such a methodology allows the development of quickly, effectively and logically the necessary steps to solve a problem, starting from its identification and reaching its complete solution, avoiding some common pitfalls such as: implementing inadequate solutions for non-specific problems; not following the steps correctly (i.e., not performing one of them or performing the final steps first and then going back to the beginning), going from the problem to the solution without a proper analysis; Make decisions based on opinions rather than facts.

To apply MASP, several technical and administrative resources are needed: the so-called quality tools, statistical methods, training techniques, group work and project management, etc.

QUALITY TOOLS

According to Mariani (2005), in order to manage processes and, above all, to make decisions with greater precision, it is necessary to work based on facts and data, that is, information generated in the process, seeking and correctly interpreting the available information as a way to eliminate empiricism.

To this end, there are important and effective techniques, called quality tools, capable of providing the collection, processing and clear disposition of available information, or data related to the processes managed within organizations.

Such quality tools become very useful when the people who make up the organization begin to master and practice the PDCA method of process management, with the need to work and master the techniques of information processing, called quality tools within the quality and productivity management system.

5W2H

According to Periard (2009), the tool aims to identify, analyze and generate a solution to the identified problems, assisting in the elaboration of action plans by answering the key questions "What?" (What), "Who?" (Who), "When?" (When), "Where?" (Where), "Why?" (Why), "How?" (How) and "How much?" (How Much).

Thus, essential information is provided for the execution of an activity and serves as a guide in the implementation of the decisions and attitudes that one wishes to establish. Nakagawa (2014, p.1) explains how the spreadsheet, illustrated in figure 3, can be filled out:

Action or activity that must be performed or the problem or challenge that must be solved (What). Justification of the reasons and objectives of what is being executed or solved (Why). Definition of who will be responsible for the execution of what was planned (Who). Information about where each of the procedures will be performed (Where). Timeline on when the procedures will take place (When). Explanation of how the procedures will be carried out to achieve the pre-established objectives (How).

Limitation of how much each procedure will cost and the total cost of what will be done (How Much)?

Figure 3 - Example of a 5W2H worksheet

5W					2H	
What?	*Why?*	*Where?*	*Who?*	*When?*	*How?*	*How much?*
O que?	Por que?	Onde?	Quem?	Quando?	Como?	Quanto?
Realizar auditoria de 5S	Garantir os benefícios do programa	Almoxarifado	André	10/10/2017	Seguir roteiro de inspeção	R$ 450,00
Limpeza da área de produção	Garantir a qualidade do produto	Área de Produção	Nelson	25/10/2017	Com pano, balde, detergente e água	R$ 150,00
Enviar molde para jateamento	Reduzir defeitos das peças	Jatex	Carlos	15/11/2017	Retirar molde de produção e enviar com nota para conserto	R$ 5.450,00

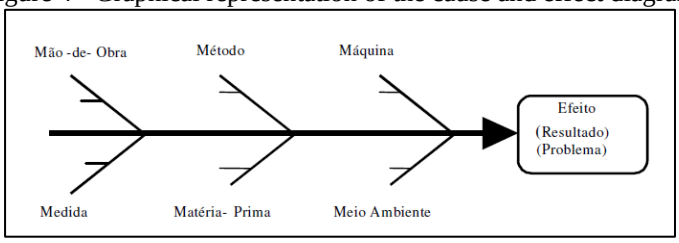
Source: Prepared by the author (2019)

CAUSE AND EFFECT DIAGRAM

Developed by Ishikawa, also called the Fishbone Diagram, or 6 M diagram, it is represented in figure 4. It is a simple and effective technique in enumerating the possible causes of a given problem.

The causes are grouped into families to facilitate their analysis, being related to the effect caused in a visual and clear way.

Figure 4 - Graphical representation of the cause and effect diagram



Source: Campos (1992, p. 18)

LAYERING

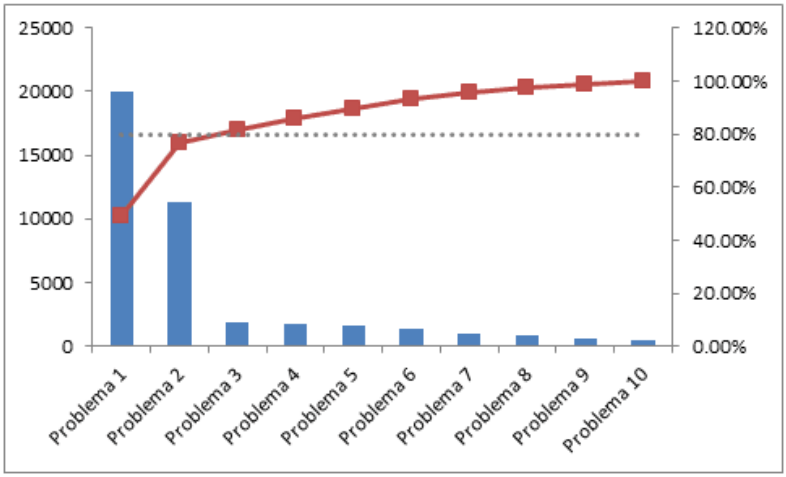
Stratification is a technique used to subdivide or stratify the problem under study into smaller parts, facilitating its investigation and analysis for later search for a solution, and there is no single standard model (each case is different). The goal is to break down or break down the problem into parts according to its origins. Taking as an example a problem of "a high rate of damaged parts on the production line", its stratification could be by: a) class, b) shift, c) machine, d) type of damage, e) operator.

PARETO CHART

The Pareto chart serves to quantitatively represent graphically the frequency of losses that are being analyzed, in descending order, identified from stratification.

Pareto states that 80% of the consequences stem from 20% of the causes. In other words, most problems have few causes and if they are eliminated they can bring excellent results (VIEIRA, 1999). Figure 5 shows an example of a Pareto chart.

Figure 5 - Example of a Pareto Chart



Source: Prepared by the author (2019)

BRAINSTORMING

This technique can be translated to Portuguese as brainstorming. It is developed through a group dynamic, aiming to explore the creativity of all participants. In this way, it is possible for participants to come up with new ideas that can help in solving a particular problem under analysis. During the execution of this method, people should express their opinions freely, without restrictions or criticism, as debates and criticisms inhibit people from presenting their contributions (TZASKOS and GALLARDO, 2016).

At the end of the meeting, numerous ideas are generated in the analysis of the facts addressed about the problem. It is up to the participants to analyze and select the most relevant alternatives, so that these creative solutions generated by the group can be put into practice.

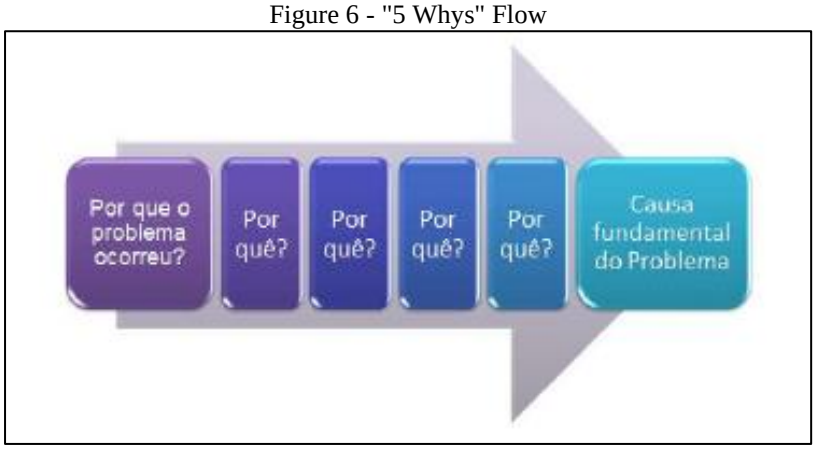
GEMBA

Gemba means "real place", a term in turn representing an attitude. Employees are encouraged at all times to go to the location where the problem is happening in order to collect data so that they can make a decision and later solve it. To solve a problem, it is necessary to fully understand it and going to the site will make the employee have his or her own view of the facts that make up the problem. Encouraging all employees to go to Gemba is not only a way for the company to solve problems faster, but also a way to save money.

"5 WHYS"

The 5 whys methodology is based on the principle of asking five times why a problem is occurring, always taking the previous answer as a reference, in order to discover the root cause of this problem. This method is widely used in the area of quality, but it applies in any environment where there is a problem that needs a solution. Its application is very simple, and it can be applied in any systematic problem analysis. Figure 6 shows the flow of questions to solve a problem.

Figure 6 - "5 Whys" Flow



Source: Prepared by the author (2019)

ANALYSIS AND DISCUSSION OF RESULTS

The three steps of the proposed method will be detailed below.

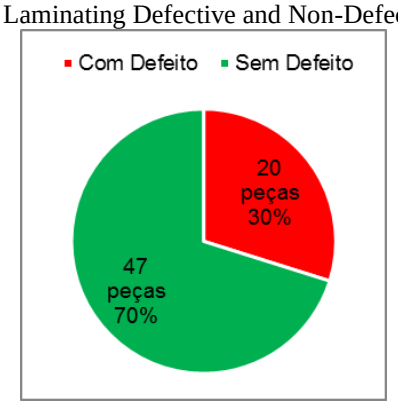
IDENTIFICATION

Initially, it is necessary to measure the size of the problem between the current situation and the desired one, demonstrating the influence of the problem on the company's results, through the survey of losses and the possible benefits that will be obtained with its elimination. For this, historical data can be used or a new data collection can be carried out (PIECHNICK, 2014).

At this stage it is important to distinguish what is really important within the various problems that make up the environment under analysis. Thus, the proposed method suggests the application of the Pareto chart and a more detailed stratification of the problem to aid in decision making. It should be used in order to identify losses and prioritize them, moving analysis efforts toward the problem that has the greatest impact on results.

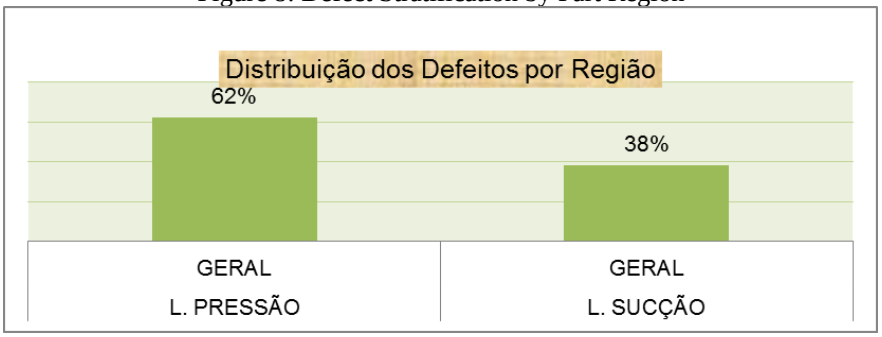
Figures 7, 8 and 9 show an example of defect stratification in a part.

Figure 7: Laminating Defective and Non-Defective Parts



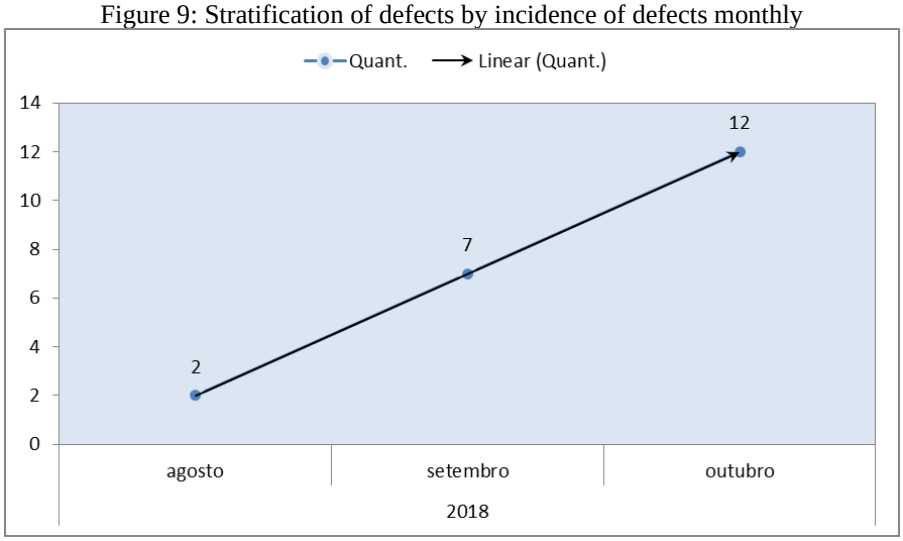
Source: Prepared by the author (2019)

Figure 8: Defect Stratification by Part Region



Source: Prepared by the author (2019)

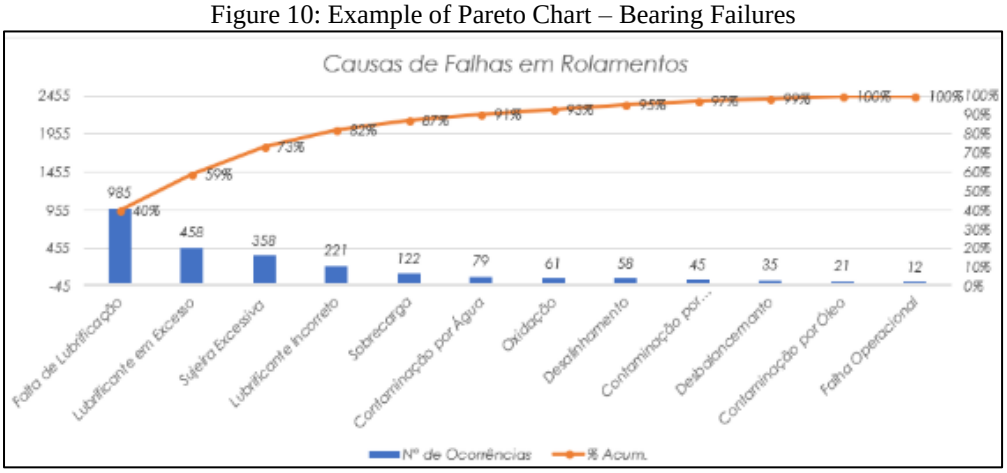
Figure 9: Stratification of defects by incidence of defects monthly



Source: Prepared by the author (2019).

Figure 10 shows an example of a Pareto chart quantitatively representing the cause that most impacts the problem of bearing failures, in this case it would be the lack of lubrication and the cause that deserves priority in the resolution.

Figure 10: Example of Pareto Chart – Bearing Failures



Source: Prepared by the author (2019)

ANALYSIS

With the data and analysis of the problems raised, a meeting is held to carry out the analysis stage of the anomalies of the process, with the main objective of raising the root cause and establishing blocking actions that prevent the recurrence of this problem.

The analysis is conducted by the improvement group's leadership team. First, a Brainstorming is carried out, exploring the capacity and ideas of each participant, involving them and defining hypotheses that can influence the problem.

The most relevant hypotheses should be enumerated through the Ishikawa tool and analyzed through the 6 M's next to the "5 Whys" to arrive at the root cause of the problem. After finding the most impactful causes and analyzing them through Gemba at the site of incidence of the problem, countermeasure actions are defined for the problem.

ACTION

In this phase, the action plan is prepared using the 5W2H methodology. This plan aims to manage and put into practice the actions generated in the analysis stage and ensure the execution of the tasks.

This action plan should be drawn up with the participation of all those involved. In addition, there should be a general consensus on the definition of control items, such as: the actions to be performed, the reason why it should be performed, the person responsible for the action, how it should be performed, the deadline for execution, where it will be carried out, and the cost involved in the execution of the proposed action. Figure 11 shows a model for the application of the 5W2H method.

Figure 11: Action plan

PASSO 3 - PLANO DE AÇÃO

Revisão nº: 0

Causa Fundamental					
Ação nº	**Descrição da Ação / Melhoria** (preencher formulário de sugestão)	**Responsável**	**Prazo**	**Custo**	**Status**
1					
2					
3					
4					
5					
6					
7					

Source: Prepared by the author (2019)

Once the action plan (5W and 2H) has been defined, and the measures have been implemented, the next step is to monitor the process, recording data (collecting information) on the verification sheet, of which the model is shown in Chart 1. This tool, in addition to favoring monitoring, helps to evaluate the effectiveness of the corrective actions adopted.

After the implementation of all the countermeasures established in the action plan, specific indicators are created to assess the efficiency of the actions. After the closure of the implementation group of the proposed methodology, it is necessary to implement the indicators in order to control and identify divergence in the processes, documenting the results through a verification sheet for monitoring over time.

FINAL THOUGHTS

Losses are intrinsic to any production system and companies must be focused on identifying them, in order to control or eliminate them, ensuring increased reliability and productivity of their processes.

The application of this simplified method makes it possible to comply with corrective actions that contribute to the improvement of the results of the company under analysis. In addition, it allows professionals with little experience with quality tools to develop new knowledge in the fight against losses, creating a culture focused on the treatment of losses, establishing priorities over problems.

The use of this proposal makes it possible to neutralise and eliminate the effects of the problems. It develops the individual skills of employees, contributing to the continuous improvement practices of companies. However, the method is a proposal aimed at solving simple and low complexity problems, i.e. problems that recur or have a higher complexity, it is convenient to consider the most complete analysis methodologies, such as MASP.

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