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Analysis of the Process of Painting Mechanical Parts in an Industry of the Industrial Pole of Manaus

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Abstract

The fierce competition between companies gave greater power to the consumer, forcing managers to focus more on the quality of their products and services. This article presents the joint application of quality control and planning tools, using specific methodology, aiming to improve the quality of painting of motorcycle parts. Quality is an essential attribute to the products and services offered by companies in the market and for them to get ahead of their competitors they must look for ways to become more competitive and innovative every day, because currently only those who are ahead prepared to take advantage of the opportunities that come your way. The improvement was carried out in the ABS painting sector of a multinational motorcycle manufacturer. This work will address the biggest problems that lead to water contamination in the painting process, where we will collect such information in indicators and spreadsheets in the production process and we will use quality tools to eliminate or reduce the repainting process caused by water contamination.

Keywords: Contamination. Painting. Quality.

Palavras-chave: Contaminação. Pintura. Qualidade.

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1. INTRODUCTION

Technological advances in recent decades have accelerated the process of globalization, allowing competition between companies to take place internationally. This made quality, which often did not receive great attention from managers due to the difficulty in measuring its benefits, became something indispensable for the success of companies. According to Montgomery and Runger (2009), the quality of products and services has become an important decision factor in most businesses, and a consumer is likely to consider quality as important as cost and delivery time.

Consequently, improving quality has become a concern for many companies. According to Quinquiolo (2002), continuous improvement and improvement are essential 3 to ensure the success of any activity and mean making changes with positive influences on the production system and services to improve quality and productivity and, consequently, reduce costs over time. For Montgomery (2009), quality improvement means the systematic elimination of defects, which can include losses and rework, errors in documents and the time wasted to redo something that could have been done right from the first time.

Pierozan (2001), states that car consumers buy before with their eyes, and the quality and color of the finish undoubtedly determinant in the option of purchase. The paint and external finishing of an automobile represent very important quality requirements for most consumers, as they are the first image that the customer has on the product.

The manufacturing process and the painting of automobiles are complex and face several factors that generate defects in the body of vehicles, thus harming the quality perceived by the customer and directly impacting the result of the automaker.

In the present work was applied a study in a company of the Industrial Pole of Manaus to identify the defects that occur in the process of painting the body of motorcycles in order to reduce these, these problems occur in the painting booths by water contamination as well as the rejection of parts by water contamination in the paint which leads to the need to develop additional actions such as repainting. For the development of the work, different production management techniques were applied and the results obtained allow affirming the validity in their application by reducing the losses due to paint defects.

2. DEVELOPMENT

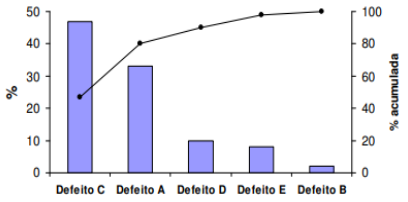
Quality tools are static and managerial techniques that help in obtaining, organizing and analyzing the information needed to solve problems (ARIOSI, 2018).

The use of tools such as Pareto, Ishikawa, Brainstorming and PDCA allowed me to test hypotheses raised, analyze productivity losses and propose improvement actions.

The Pareto diagram is a graphical feature that uses vertical bars, in order to establish an ordering of the causes of losses that must be summable. From these charts you can determine which problems should be resolved and what the priority is.

It was first presented by Italian economist Vilfredo Pareto in 1897. The diagram makes it possible to visualize the causes of a problem from the highest to the lowest frequency/severity by clearly identifying the location of the vital causes that originated the problem (ARIOSI, 2018).

Figure 01 - Pareto chart example



Source: ARIOSI, 2018

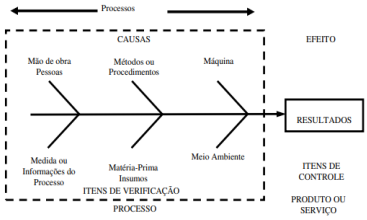
The cause-effect diagram was developed by Kaoru Ishikawa in 1953 at the University of Tokyo to represent the relationship between some effects that could be measured and the set of possible causes that produce the effect (MARQUES, 2010).

The cause-and-effect diagram is a graphical representation that allows you to easily visualize the chain of causes and effects of the problem. The diagram shows the relationship between quality characteristics and factors and represents the relationship between the effect of all possibilities of causes that contributed to this effect (MARQUES, 2010).

For each of the effects there are numerous causes within the categories such as the 6 M'S: method, labor, raw material, machines, measurement and environment.

Through a list of possibly causes the most likely are identified and selected to a better analysis.

Figure 02 - Cause and effect diagram layout



Cast iron: WHITELEY (1992)

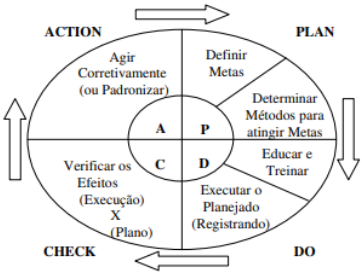
Brainstorming is an expression of the English language structured from the combination of two words: "*brain*", which means brain, intellect and "*storm*", which means storm. It can be translated as a brain storm or, as you speak most commonly, a storm of ideas.

It is a group dynamic widely used by many companies, especially as an alternative to solve specific problems, elaborate new ideas or projects and/or carry out, planning, always seeking to combine information with the basic stimulus of creative thinking (ARIOSI, 2018).

PDCA is used by organizations to manage their internal processes in order to ensure the achievement of established goals, taking information as a decision-making factor.

Figure 03 demonstrates the graphic representation of the PDCA phases, and the first phase corresponds *to the PLAN* (planning) in which the ideal goals (control items) of the analyzed process are defined, establishing the methods for its achievement (C. MARIANI, 2005).

Figure 03 – PDCA Method



Source: Campos, 1992

A segunda etapa compreende o *DO* (execução) sendo necessários a educação e o treinamento das pessoas envolvidas, com a execução efetiva das ações planejadas. Paralelamente, as informações geradas no processo são registradas (C. MARIANI, 2005).

A terceira etapa é composta do *CHECK* (verificação) e tem por objetivo comparar a execução (a partir dos dados registrados) com o planejamento. Aqui se pode notar se os resultados propostos inicialmente foram ou não alcançados (C. MARIANI, 2005).

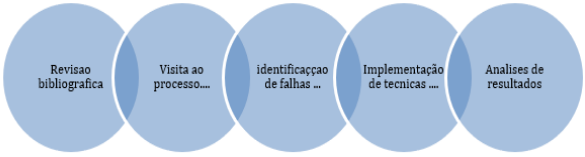
A quarta etapa, *ACTION* implica em ações corretivas; nesta fase, a partir dos resultados alcançados, tem-se dois caminhos distintos a seguir: se a verificação mostrou que não foi possível atingir os resultados propostos, deve-se partir para o estudo de ações corretivas e a seguir retomar o método PDCA (C. MARIANI, 2005). porém se os resultados propostos foram atingidos, deve-se então padronizar o processo, assegurando assim sua continuidade.

3. MATERIALS AND METHOD

This work sought to reduce defects caused during the painting process of plastic parts. The paint booth is used to carry out the painting of plastic parts for motorcycles of a company of the industrial pole of Manaus.

For the development of the work, it was necessary to make a visit in the process to know and identify possible flaws during the process of painting plastic parts. Pareto graphs were used based on productive indicators, cause and effect diagram for surveys of possible failures during the process and PDCA to plan possible solutions.

Figure 04. Analytical structure of work



Source: Authors 2021.

4. RESULTS AND ANALYSIS

4.1 The painting process

The painting process begins with the loading of plastic parts, goes through the pretreatment process where to perform the cleaning of impurities, goes through the water drying kiln, goes through the process of painting the parts, goes through the paint drying study, unloads the painted parts on the conveyor, performs the visual inspection of the parts, performs the application of track and storage of the parts until its final process that is the assembly on the motorcycle figure 04.

Figure 04 – The process consists of (a) loading plastic parts, then it passes (b) through the pretreatment, then (c) through the water kiln, which passes (d) through the painting process, which passes (e) the paint study, which discharges the inspection process to (f), then (g) passes to track application. Finally (h) for the storage process.

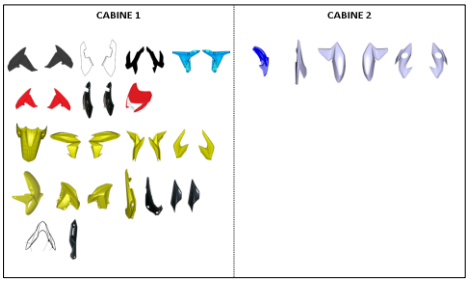
Figure 04 - Motorcycle assembly process

Source: Plastic part painting company, 2021

4.2 Plastic parts.

The plastic parts are painted in a company of the industrial pole of Manaus following a continuous process through 2 painting booths as shown in figure 04. As can be seen from the diagram in Figure 05, each cabin paints a part group with its respective pieces and models.

Figure 05 - Example of parts distribution by paint booth



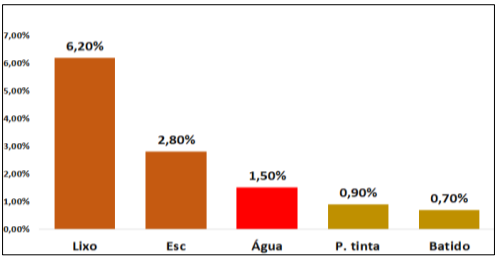
Source: Plastic part painting company, 2021

After knowing the process of painting plastic parts, the rejection indicators of parts were evaluated where the 5 major defects of the painting process were stratified according to pareto 06 graph.

4.3 Rejection indicators

Analyzing figure 06, we observed that garbage and draining have a significant percentage, but are already being treated in parallel to reduce the defect index. For the water defect has no expected treatment, where this defect was chosen to reduce the internal rejection rate.

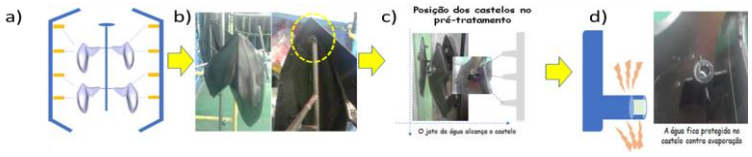
Figure 06 - 5 major paint defects



Source: Authors, 2021

First, the processor was mapping to identify where water could accumulate, as shown in Figure 07. And it was identified that the accumulation of water was coming in the pre-treatment process, where it performs the washing process to remove impurity from the process.

Figure 07 – (a) washing process of the parts, (b) and (c) positioning of the pieces in the gancheiras and (d) accumulation of water in the castle of the piece.



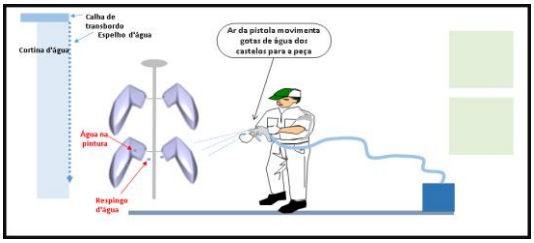
Source: Authors, 2021

In figure 08 is shown where the accumulation of water occurs, how the castle is on the inside of the piece, in the manual painting process figure 08, the painted cannot visualize and with this ends up applied the paint and it is rejected and sent to the recovery process.

4.4 Manual paint flow

Industrial painting can follow two concepts: serial manufacturing paint and field painting. In the first, the process takes place in fixed installations, such as cabins and greenhouses. In the second, the application of painting takes place in mobile installations, which can be represented by blasting machines, pistols and other equipment (KRÄNKEL, 2014).

Figure 08 - Manual painting process



Source: Authors, 2021

Figure 09 – Flow of the recovery process, (a) inspection process, (b) defect removal process, (c) stores the recovered parts in the car and if it is unable to recover the part (d) it is scrapped.

Figure 09. Flow of the recovery process

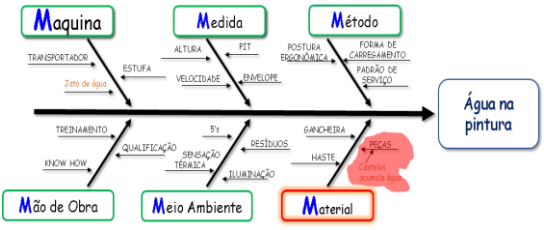
Source: Authors, 2021

In Figure 09 it is possible to observe the recovery process of rejected parts where it is clear that not all parts can be recovered.

4.5 Pareto diagram.

Using the cause-and-effect diagram as shown in figure 10, where it is observed that in the material item, the item piece presents water accumulation because it presents internal castle in the piece, but this item cannot be removed, because it has a purpose in the assembly of the motorcycle.

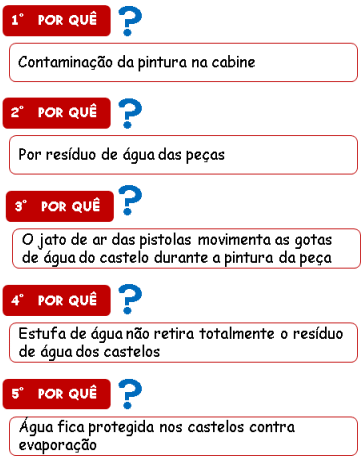
Figure 10 - Cause and effect diagram



Source: Authors, 2021

The 5-why technique was also implemented to understand the problem: Water accumulation in ABS cabins.

Figure 11 - 5 Why



Source: Authors, 2021

From this tool it was concluded that it is possible to observe that during the implementation of the model, the invasion of water to the castles was not taken into account.

To solve the problem, we did a *Brainstorming where* came some ideas such as:

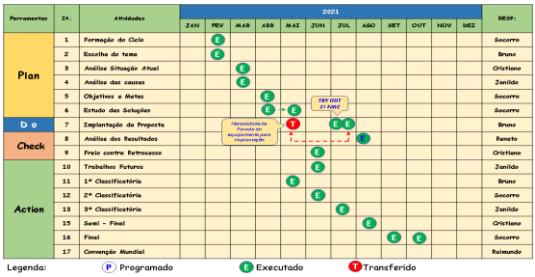
- include paper masqueamento in the piece;
- inclusion of a person to perform the suction of water;
- include two ventilators in the last pre-treatment process;
- Direct pretreatment air insufflation;

After evaluating the 4 proposals, the choice of the most viable proposal was to be the number 4 (Direct pre-treatment air insufflation).

4.6 Proposal: Direct Pre-Treatment Air Insuftation

To evaluate the viability of the activity it was necessary to verify if it would change any characteristic of the process, with this was elaborated a schedule of activity based on PDCA as shown in Figure 12.

Figure 12 - Activity schedule



Source: Authors, 2021

A photographic record was made in the pre-treatment to understand the functionality of the equipment as shown in Figure 13.

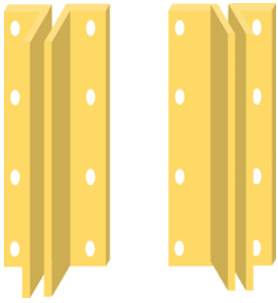
Figure 13 – Insufflation system

Source: Manaus industrial pole company, 2021

Insufflation system is directed to the entrance of the water drying oven to retain heat inside the greenhouse as shown in Figure 13.

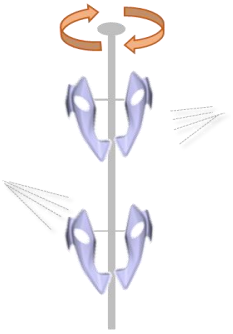
The proposal is to install two fins (figure 14) directed to the piece, where it makes the rod with pieces perform a turn (figure 15) so that the water droplets leave the castle and dry in the water drying process.

Figure 14 – Fins



Source: Authors, 2021

Figure 15 - Stick in process of rotation



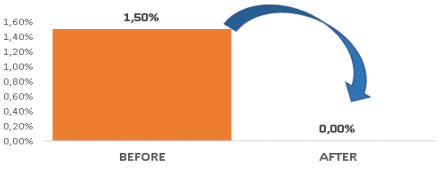
Source: Authors, 2021

After the implementation of the targeted system, the problem of water contamination in the painting process was solved.

4.7 The value of results

After evaluating the results, we obtained the expected result, where a 100% reduction in water contamination was reduced, as shown in Figure 16.

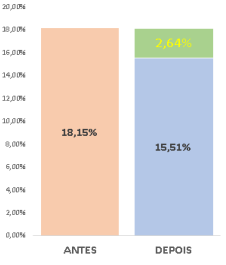
Figure 16 - Graphic defects before and after



Source: Authors, 2021

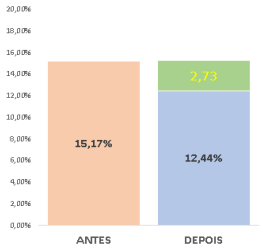
Where other gains were obtained in the painting process related to: reduction of sanded parts, reduction in ink consumption by refinish and reduction in the number of scrapped parts.

Figure 17 - Pareto Chart: reduction of sanded parts.



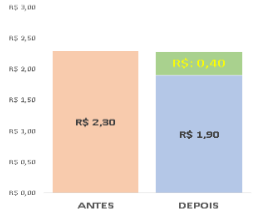
Source: Authors, 2021

Figure 18 - Pareto Chart: reduction in ink consumption by refinish



Source: Authors, 2021

Figure 19 - Pareto Chart: reduction in the amount of scrapped parts



Source: Author, 2021

According to the results after the implementation of the improvement there was a significant impact on the production chain in the reduction of performance indicators.

5. CONCLUSIONS

With the development of the work, the proposed objectives were met by improving the painting process of motorcycle parts, it was possible to reduce or eliminate the process of repainting parts in the painting booths and the rejection of parts due to water contamination in the painting.

Several quality managements tools, Pareto, Ishikawa, Brainstorming and PDC were applied, which helped in this continuous improvement process. A system of insufflation allowed the total reduction of defects caused by water contamination and bringing improvement in the performance of the production chain and reducing costs in the company.

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