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CAD / CAM Application for the Development of Submerged Pump Maintenance Tools

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The design and implementation of maintenance tools is used in CAD / CAM tools, in order to make the necessary improvements in the whole process of disassembly of the equipment in question, and mainly to reduce the process time and eliminate the risk. breaking the most fragile parts of the equipment. The objective of the work is to elaborate the toolkit, to reduce the disassembly time and to eliminate damage to the equipment and its respective trajectories, with which the machine performs the machining of the designed drawing, were applied to the resources through a CNC language. (Computer Numeric Command) on a CNC lathe and a machining center. The elaboration of this project based on a CAD system, in this case Solid Works. The average time for disassembly of the equipment was around 2h, now with the proper use of tools, the same process had a time drop to 40 minutes, seen as a great time saving in the disassembly process.

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Abstract

The design and implementation of maintenance tools is used in CAD / CAM tools, in order to make the necessary improvements in the whole process of disassembly of the equipment in question, and mainly to reduce the process time and eliminate the risk. breaking the most fragile parts of the equipment. The objective of the work is to elaborate the toolkit, to reduce the disassembly time and to eliminate damage to the equipment and its respective trajectories, with which the machine performs the machining of the designed drawing, were applied to the resources through a CNC language. (Computer Numeric Command) on a CNC lathe and a machining center. The elaboration of this project based on a CAD system, in this case Solid Works. The average time for disassembly of the equipment was around 2h, now with the proper use of tools, the same process had a time drop to 40 minutes, seen as a great time saving in the disassembly process.

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1. Introduction

With the increased use of these tools, coupled with technological innovations and market competition, has led to a significant drop in their price, making it increasingly possible to exchange 2D CAD software for 3D modelers.

Where you can access Computer Aided Engineering (CAE) and Product Data Management (PDM) CAD / CAM technologies in a single software. These tools (Software) have numerous features for modeling Solids, making projects run with high technology, speed and especially accuracy.

The use of software in the machining process, carried out by machines and tools, has its continuous development based on solutions to increase productivity and the quality of products and processes. Reducing the design cycle in a product's manufacturing and competitiveness requires the use of high technology equipment to obtain complex geometry.

Today, with the integration technology of machines, equipment and systems on the shop floor, greater flexibility and productivity is sought, utilizing technologies and resources that range from numerical commands to automated computer-integrated manufacturing environments. Notable in this approach are computer-aided design systems, CAD systems, as well as CAM-assisted manufacturing.

The objective of the work is to improve the sequence in the process disassembly handling, to conduct the routines to produce work results, to obtain the possibility of gains and better results, to have agility and care in the act of maintenance and disassembly, to design and to execute the kit. appropriate tools for the assembly and disassembly process, and ensure customer satisfaction of receiving the product within the estimated time.

2. Bibliographical Review

This research presents the main concepts that were explored in the work, from the literature about the studied problem, to make the studied process more efficient and effective, adding value to the organization inside and outside it.

2.1 Process Optimization

Process mapping can benefit companies by providing a set of techniques that can simplify the relationships between the various processes of an enterprise [1].

For [2] the advantages of agile methodology are to minimize the risk of the process and the system that it supports does not fit the business reality. However, in agile models there is a limited possibility of using formal methods for process optimization, which can be overcome using the traditional methodology.

The process refinement phase should take care of analysis and decision making based on the results found in the monitoring and control phase. This is the phase responsible for achieving and creating the continuous improvement of corporate business processes. The process refinement should be made in comparison between the results obtained from the processes and the established goals, being the optimization or process improvement a consequence of this work [3].

According to [1], although there are different models for the implementation of process management, they have in common the cyclic form, for this reason, we talk about “BPM cycles”. A systemic model composed

of events, activities and tasks, with the purpose of organizing the flow and value exchange operations between suppliers and customers should guide the BPM [4].

2.2 Manufacturing Process

For any organization to be managed through business processes, it is necessary to create a knowledge management culture, which means to win over people to practice cooperative behavior [5]. Process-managed organizations need to engage and motivate the people involved in the activities to achieve the expected results. Participants should be aware of and involved with the process, assuming that they are the ones who influence the performance of the process.

[6] They consider that teams must take into account the size of the organization and the complexity of business processes. For large companies the author proposes an initial step that includes a description of all organizational processes, so an agile approach is not advisable and the traditional one should be applied. Second [7] the alignment between business processes and organizational strategy is found in the adoption of practices and methods aimed at continuous improvement in business processes. Thus, it is possible to see the relevance of the association and the necessary alignment between organizational strategy and business process compliance, characterizing the management of these processes as a means of reaching a strategic direction, which is established as a critical success factor. [7].

2.3 CAD / CAM System

The introduction of CAD / CAM technology represented a great innovation for dentistry, as it made it possible to make dentures in a shorter time and in the office itself. In addition to time, one of the great differentials of the CAD / CAM process is the use of controlled industrially manufactured materials, free from imperfections and porosities. We can cite as advantage, a fully computerized manufacturing process, which allows to minimize failures and distortions that may be present in the manual process, as well as allowing the reproducibility of the process. These factors, associated with the accuracy of computer programs, allow the production of better quality restorations with better marginal adaptation. [8]

[9] They conducted this study to investigate the accuracy of marginal fit of zirconia infrastructure fabricated with different digitization (CAD) and milling (CAM) processes to obtain optimal tilt inclination (4 degree abutment, 4-5 axial height mm).

CAD / CAM restorations have better marginal fit or are compatible with conventional ones. [10] Restorations with jagged edges such as onlays and veneers appear to be more difficult to reproduce; Studies show that the marginal adaptation of these CAD / CAM system restorations is lower, although within clinically acceptable limits [11].

3. Tools and Methods

This study was performed in an Electric Motor Rewinding company, where the flow was surveyed, through the process mapping, the identification of the problems, the need to have an adequate tool, as the interview with the company, was done. After identifying the difficulties faced by the problem, the proposal was presented for the improvement of the dismantling process of submerged pumps, using a toolkit proposed

to reduce the time, risks and final cost.

4. Application of Study

The previous process took an average of 2 hours to dismantle a submerged pump according to the flow chart below.

4.1 Process Flow (Old)

The initial process is delivered to the receiving department, along with the expert technician to identify the problem and generate the work order, after using the three tools, spare parts are required for service completion, until customer delivery. Final.

The figure below represents the sequence of tools used, such as: Tool 1, 2 and 3.

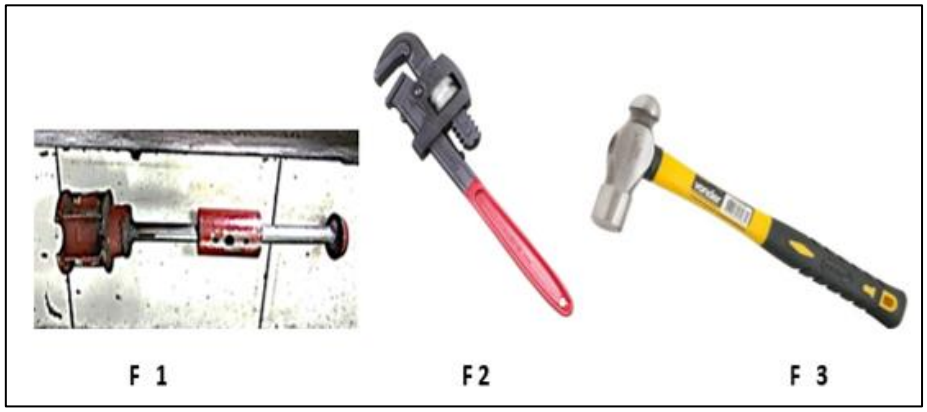

Figure 1 - Tools F1, F2 and F3.

Source: Author

4.2 Problem Identification

In the handling process of the tool step 1, 2 and 3 several stops in the disassembly sequence have been identified due to the use of the tools, the process is repeated in the closing of the service generating costs with generally damaged parts and delays due to the high hours. in the process of disassembly and assembly of the whole assembly.

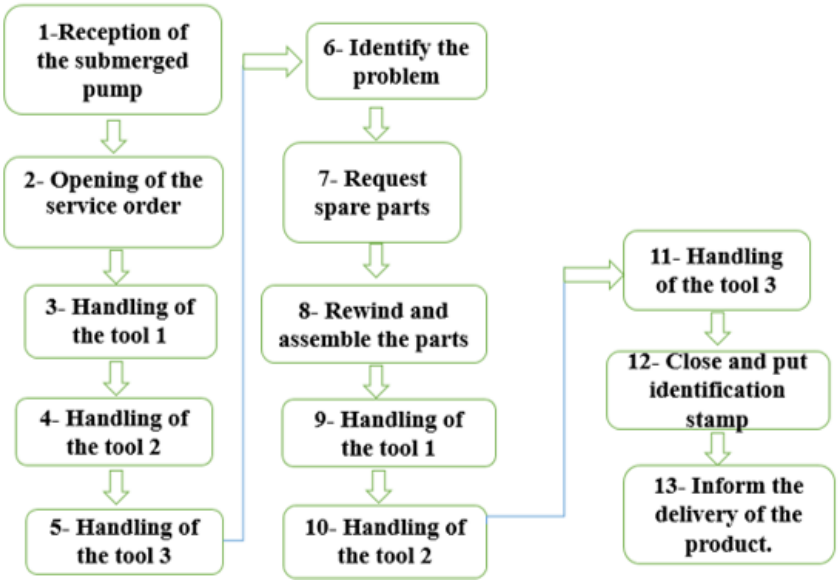

Figure 2 - Old Flow
Source: Author

As shown in figure 1 above, it is represented by the tools used in the previous process. Flow demonstrates each step during disassembly of submerged pump.
Figure 3 below represents tool F1, being used in the disassembly process of the pump motor cover.

Figure 3 - F1 Tool Coupled to Cap
Source: Author

To remove the motor cover of the pump, it is necessary to lock the tool F1 with the screws that are part of the cover.

Figure 4 - F1 Tool
Source: Author

Figure 4 represents the pump cover removed. To remove the pump motor cover that is mounted to the

equipment with moderate pressure, manual axial movements must be made on the movable part of the tool F1 about the tool axis.

The hammer shown in figure 1 as a tool F3 is used for cover assembly removed in the previous process. With improper use of the F3 tool, many cover failures occur during this process.

Figure 5 - Tool 2
Source: Author

Figure 5 represents an improper process, the pump is fixed directly in the vise, for the removal and subsequent assembly of the threadbare plastic part of the equipment, requiring the use of a screwdriver, causing possible damage to both the plastic part and the part. cylindrical section of the pump that is attached to the bench vise.

4.3 Improvement Proposal

Design and manufacture a toolkit that can be used for multiple tasks, reducing the amount of previously used tools, enabling faster and safer disassembly without damaging pump disassembly, and automatically reducing process setup. Figures 6,7 and 8 represent the Toolkit.

Figure 6 - Hexagonal Central Flange
Source: Author

The hexagonal central flange Figure 6, was manufactured following all quality standards, and heat treatment between 40 ~ 45 HRC, this guarantees resistance and durability to the equipment.

Figure 7 - Interchangeable withdrawal shaft
Source: Author

The interchangeable withdrawal shaft figure 7 is named because it can be used in conjunction with the tool of figure 6, the union of this set is made through the thread that is at the end of the shaft and inside the hexagonal central flange.

Figure 8 - Adjustable Wrench
Source: Author

The adjustable wrench figure 8 is used in conjunction with Figure 6 to assist in dismantling part of the pump, details that will be shown later.

Figure 9 - Pump Motor
Source: Author

Figure 9 represents the submerged pump in disassembly process. The submerged pump in question is divided into two main parts, motor according to figure 9 and Water pump figure 10.

Figure 10 - Water Pump
Source: Author

Figure 11 - Tool Kit Coupled to Pump Motor Cover
Source: Author

Figure 11 represents the tools of figures 6 and 7, being used simultaneously in the process of disassembling the central motor cover of the pump with axial manual movements.

Figure 12 - Motor cover removed
Source: Author

Figure 12 shows the pump motor center cover removed quickly and without damage.

Figure 13 - Hexagonal Center Flange Coupled to Pump
Source: Author

Figure 13 represents the hexagonal central flange coupled to the water pump for disassembly.

Figure 14 –Drive Fixed Pump for Unscrewing Plastic Part
Source: Author

Figure 14 shows the pump set correctly in the vise for removal of the screw cap. In this process the tool of figure 6 is fixed to the plastic part with the aid of screws and nuts, to unscrew it, with the proper use of the adjustable wrench of figure 8, it is possible to remove the lid without the risk of breakage and setup reduced.

Figure 15 - Disassembled Pump
Source: Author

Figure 15 represents the dismantled and breakable dismantled pump in the plastic parts, this shows the result in applying the improvement in the construction of a suitable toolkit for the entire pump disassembly process.

The current flow below, demonstrating the reduced process amount using only one toolkit, has been able to reduce tools 1, 2 and 3.

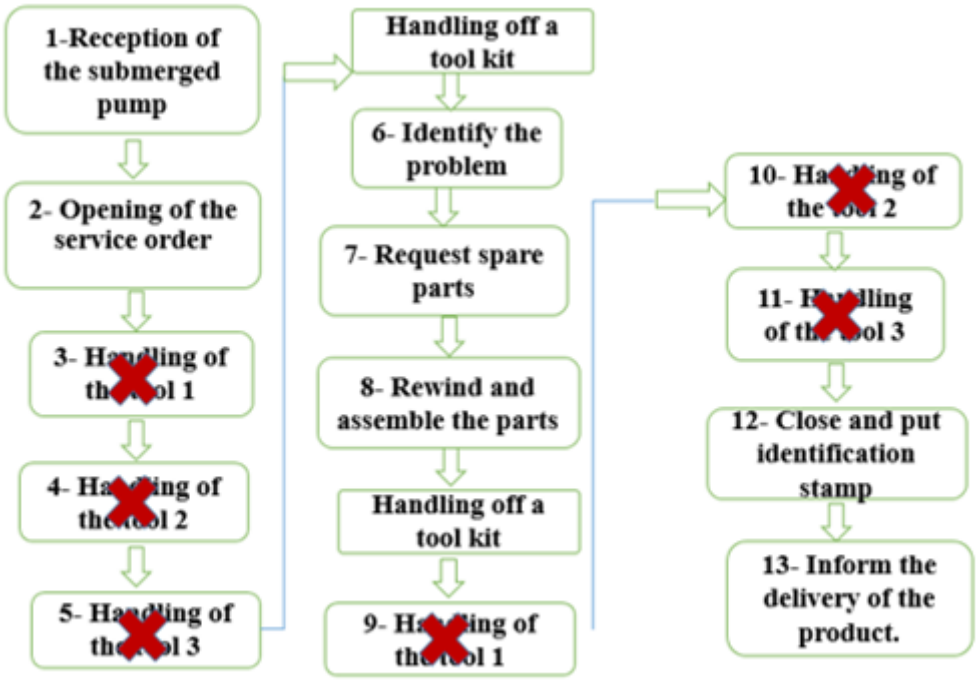

Figure 16 - Current Flow
Source: Author

With the application of the new method, the process flow reduced five steps, making the process more efficient, improving process time without compromising the correct maintenance.

5. Results and Discussions

With the conventional method the disassembly lasted around 2 hours, and with the new properly manufactured toolkit, it is possible to perform the same process around 40 minutes, considering the normal working conditions.

5.1 Tool construction

The elaboration of the Toolkit started with a project, which was specifically developed in SolidWorks, where all the 2D and 3D drawing was elaborated. The figure below represents the toolkit that was developed.

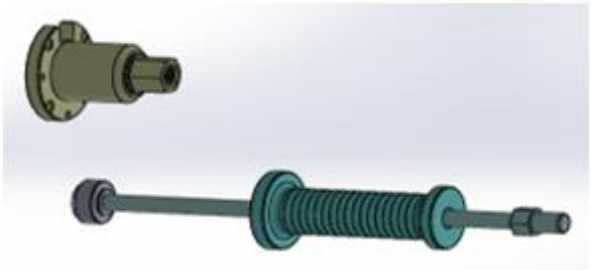

Figure 17 - Final Drawing
Source: Author

With the use of this software, it is possible to make these sizing checks also in 3D design, which greatly

facilitates the detection of possible construction errors and can have a better visualization of the problem to be corrected, saving time in the development of the design. special tool, including simulating the procedures that the tool will perform when making use of disassembly, such processes as pre-drilling, hole finishing, roughing and finishing etc.

5.2 Comparison of Results

The result below informs the hours gained during the process, reducing the time per service.

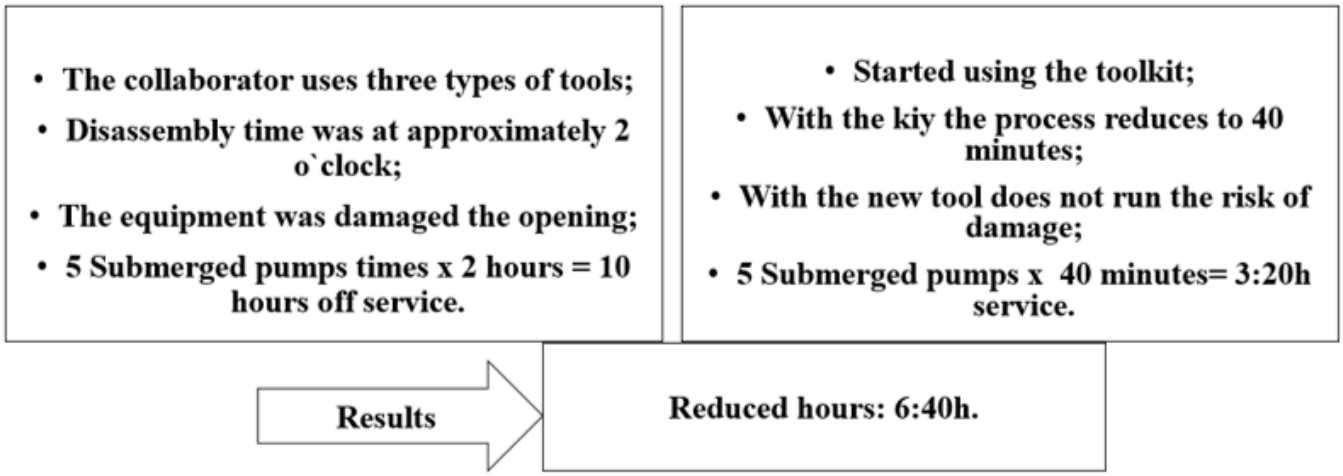

Figure 18 - Results
Source: Author

Using the toolkit of Figures 6,7 and 8, it is possible to observe the drastic reduction during the whole disassembly process of the equipment in question, without causing breakage or damage to the most fragile parts. The toolkit brought the process speed, quality and safety.

6. Final Considerations

This work was elaborated in order to present the evolution of the product design and its production, analyzing the current systems. We sought to show the theoretical basis of CAD / CAM systems and their applications in tool making, showing how the needs of these applications arose and how they can influence their production processes.

It is understood that the objective of this study was achieved, since it was possible to analyze the use of this technology and its applications in a manufacturing process of a toolkit and comparing with conventional manufacturing methods, obtaining a positive result. regarding the area of application of this tool.

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