Improvement in the Method of Assembly of a New Production Process in the PIM

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Abstract. The present article has an demonstrates the steps of making a connection fastening device that assists in the process of assembling a new production process of a white line company in the industrial hub of Manaus. The process without the presence of this device would generate leakage besides a longer process and a greater probability of error in the assembly. It was decided to build a fastening device to use it in the line, which was built through machining and later followed by surface treatment with zinc. In view of these issues, a series of actions was developed with correct decision-making based on the needs of the project after identifying the problem, its cause and resulting problems. The construction of the device was performed by the supplier, who was chosen based on the best cost and development time at the time. A device capable of solving the problem of leakage, ergonomic improvement and decrease of error variability was obtained.

Keywords: Device · Method · Machining introduction

1 Introduction

With the increasing innovation that we contemplate each day, innovative products are created daily, and with them, new production processes for complex to be assembled process must be created.

Manufacturing companies, in general, use techniques based on new assembly methods, assembly devices, and process automation to reduce error variability and improve their processes.

Hydraulic connections that are used in fluid transfer products have their greatest weakness in the connections that connect them with other objects, because they are at those points where leakage occurs.

This paper searches through machining techniques, decision making, quality tools, and project management, demonstrating the process of developing an assembly device that assists and improves the activities performed in a new production process.

There are basically four decision-making components: belief assessment, value assessment, integration ant metacognition [1].

Collective decision making is a pervasive task for humans. They must decide, where to live, where the next company site will be, or what new product will be developed

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[2]. There are several different techniques that can be used to improve decision making, either being theoretical like [3–5] or empirical [1, 6–8].

To counterpart these empirical studies [9], mathematical theories have been developed to try and explain how social decisions are made as well as to give a possible guideline on how to make these decisions [3, 10, 11].

Ishikawa diagram was invented by Kaouru Ishikawa, one of the quality pioneers in Japan during the 60s. It is considered one of the seven basic quality tools, it is also known as fishbone diagram, since it reassembles a fishbone structure, as well as cause-and-effect diagram, because it shows possible causes for the observed phenomena [12–14].

2 Development

The development of the new production live was made by using the following steps: a problem identification, using Ishikawa Diagram, passing thru a machining study and finalizing with creating an assembly standard procedure.

The production line that will be discussed below is for a product that comes from a family of beverage making assisted devices, which explains why it is important that no leakage occurs between connections.

2.1 Problem Identification

The hydraulic connections in the product are flanged and threaded, which means that, there is basically a nut that if it's not securely fastened will lead to a leakage. Through an Ishikawa Diagram (see Fig. 1), it was found that there are problems related to labor, which is represented as operational error, material problems, due to the thread of the male or female connections being out of specification leading to an improper fixation by the operator causing leakage, and method due to the manual work used that forced the operator to use movements that are not ergonomic leading to a waste of time.

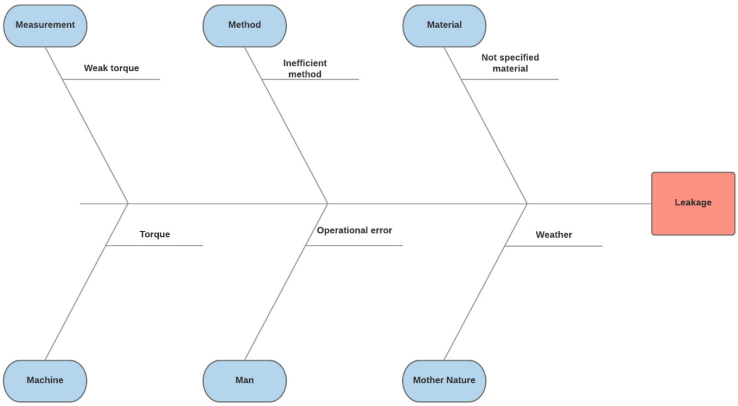

Fig. 1. Ishikawa diagram, Source: Authors

From observing the diagram as well as interviewing peers inside the line it was possible to conclude that the assembly method was inefficient, because the operator use their hands to fix the connections, causing a fragile union between the parts, and was them used as the chosen root-cause

2.2 Starting the Project

For the product assembly process, specific points were selected from the subassemblies of the valves that carry the water to the whole circuit of the beverage machines model A, these valves, like the valve in Fig. 2, require special care, since a leak can easily happen if the fitting of their connections are not well done.

Fig. 2. Solenoid valve used in the model A, every gap is a possible leak point. Source: Authors

As a solution to the leakage problems encountered in the valve connections, assembly devices have been designed so that the connection of these valves is done as accurately as possible. For this, a benchmarking of the previous process was performed, using a device with rails to tighten the male or female connections on the valves, which reduces the possibility of a human error occurring during the process.

This device was used in a dishwasher line, which needed to have a good tightness between the pieces and was adapted for the process of assembling a beverage machine. To make the device flexible, cribs were developed for each selected valve that needed to be fitted, reducing the variability of tightness between one part and another.

2.3 Developing the Device

The first step to develop a device, is choose a supplier capable enough to develop the product. In this case, we made a contact with 2 suppliers (Table 1) that came to the company to understand our main needs, the process and the specs of the final product.

After the price was sent to us, we had to make a decision about what supplier would be the best, and according to [15], a decision making is a more characteristic task of the administrator. However, managers are not the only ones to decide, because the work must be as flexible as the decision-making, but also to make sure that the whole organization, or part of it, takes it as effectively. With this in the management hands, the chosen supplier was supplier 1.

Table 1. Suppliers and their price tag for the service

Supplier	Price (BRL)
Supplier 1	16000
Supplier 2	18000

Source: Authors, 2019

For the winner supplier, a third part contract was drawn, spare parts were ordered as well as a preventive maintenance plan. Here it is important to argument that all the suppliers for this company are in a supplier development program where concurrent engineer is applied [16–18].

2.4 Machining the Device

According to [19], machining operations are those that, at the same time, impart a shape, such as dimensions or finish, or as an element of the chip.

Groover [20] affirms that machining is used as a secondary process. In general, the secondary processes come after basic processes, whose purpose is the initial form of the blank. Machining operations are to transform as initial shapes into the final geometries specified according to the part design. Schematic diagram of the parts is shown in Fig. 3.

The manufacturing process of the devices of the machining device, the metal blocks were used, and the devices were deployed in CNC machines, seeking a greater precision during machining process. In addition, the CNC machines, for small adjustments, could be fulfilled by the supplier itself.

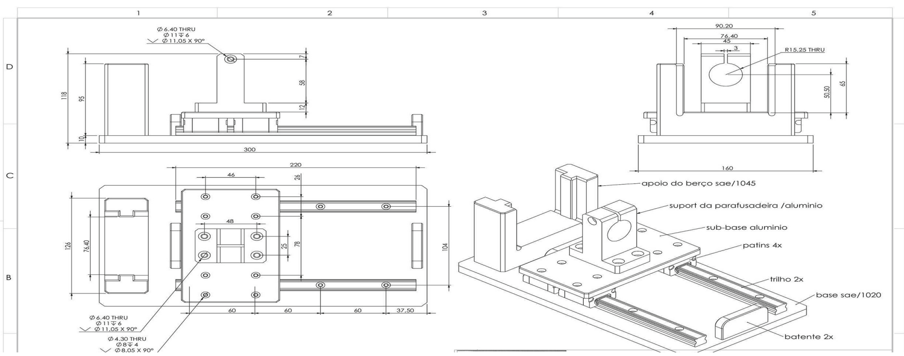

Fig. 3. Design and technical quotes of the assembly device.

After the machining process, as specified, the zinc coated device through the galvanizing process, whose purpose is to prevent corrosion and wear of the material, as it would be used more than 300 times a day inside the assembly line.

2.5 Device's TryOut

With the device implanted in the production line as well as the new process, the combination was tested and it was observed that the valve bore moved downward, which made the screwdriver used to index the part on the valve did not meet the center specified in the drawing.

In the search to find the root cause for the failure mechanism, another Ishikawa Diagram, which is shown below (Fig. 4). From its construction and analysis, it was concluded that the largest possibility of the problem was in the machining error because two devices were ordered from the supplier and only one was problematic.

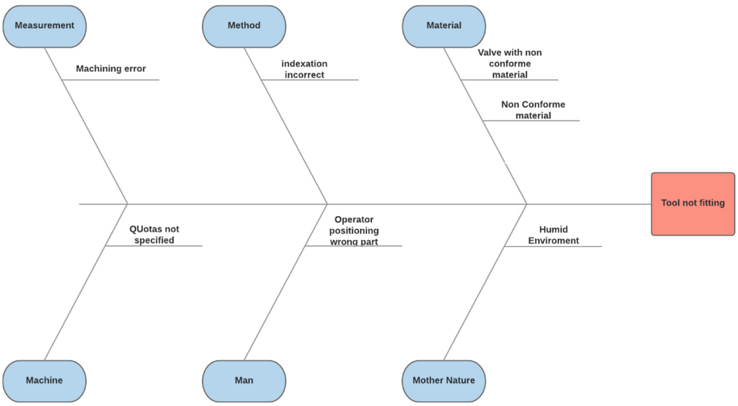

Fig. 4. Ishikawa diagram. Source: Authors

Machining errors were found in the assembly device, which allowed the cradles of the 4 mm valves to be moved upwards from their fitting point. Then there was another decision-making point because returning the part back to the supplier could result in a shipment delay and consequent delay in operating the assembly line.

However, to save time and money on transportation, the authors make the decision to internalize the final adjustments (Fig. 5), by using machining tools available inside the company, since there was enough workforce to aid the problem on location.

3 Creation of a New Standard

The assembly device also includes custom cradles and tips for the valves and their flanged connections, which required setup for mounting of other valves. In doing so, the standard that was previously using KANBAN of ready-made parts, needed to change.

With this information, a redistribution of activities was performed using Yamazumi Board as a tool, which showed the need for a second operator, since the activity time was beyond the specific TAKT time (Fig. 6).

Fig. 5. Machining process. Source: Authors.

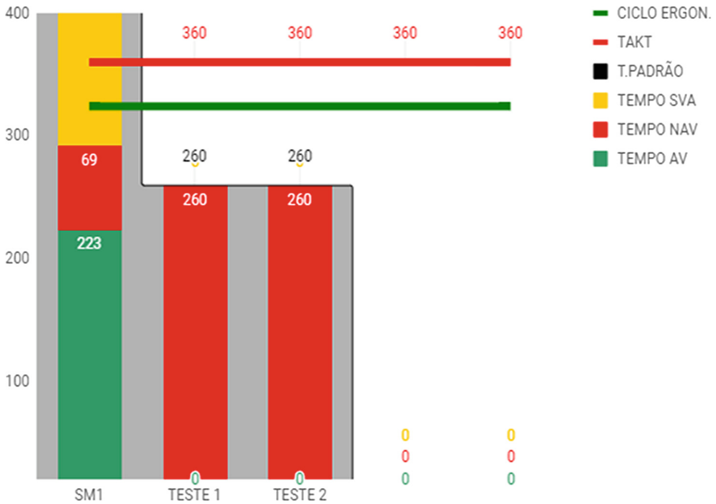

Fig. 6. Yamazumi board after, with the time not appropriate for the process.

With this information, another station was created, with the activities that are independent of the assembly device, which would not make it necessary to buy another one of the same (Fig. 7).

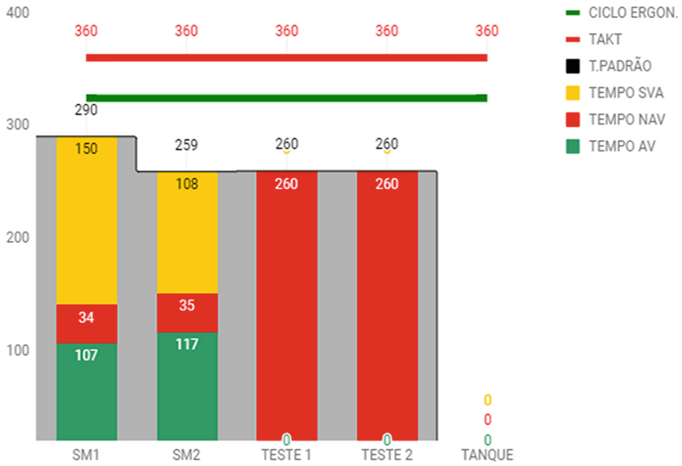

Fig. 7. Yamazumi board after, with the improvement of the new device.

4 Conclusion

Making assembly devices is one of the most effective ways to reduce the difficulty of performing a vital activity for the assembly process of a new product.

As a result of this work, a device was found able to solve the problems of leakage in the valve connections, which resulted in an effective and more accurate connection. The Ishikawa diagram built in the process was able to identify the main mode of failure, its cause and the potential effects on process performance. The decision was found to be ideal, the problem was promptly resolved, and the tests proceeded without showing any other need for change in the device discussed. As a way of keeping another backup device, the whole process was redone so that there was a third party. The use of Production Engineering tools, combined with machining techniques, was very well used to make the device that is discussed in this article, which was vital so that the device could carry out its main activity without the part being fixed outside the device. specified. In addition, it was verified that there was no problem of leakage in the connections, there was also a reduction in the total time required to fix the parts in the process, there was an ergonomic improvement for the operator and also a decrease in the error variability.

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