Setup Time reduction – CASE STUDY OF THE AMTROL M3 Line

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Abstract

This article presents an improvement proposal for the AMTROL-ALFA M3 line. It aims a subject that was discussed and studied in the Project Led Education. After an overview of the shop floor, we found different wasted time problems that lead to an inefficient setup time. Nowadays, one of the company objectives is make a change in 45 minutes that is something negative for the company. The Setup Time is the time the previous production runs stops until the time the new production run produces the first "good" product. The SMED (Single Minute Exchange of Dies) theory is used in this scientific article as a setup technic in order to reduce the company setup time. SMED tells us that the aim to perform a setup time is less than 10 minutes. If we have long setup times there is a tendency to perform long production runs to minimize the impact of a setup. This leads to larger builds of inventory and hands work in capital. However if we can perform short and simple change overs it gives us the flexibility to be able to change manufacture from one product to another us often us we like in other to meet the changing customer needs and without expense of excess inventory. By implementing setup technics we will reduce the number of startup errors and eliminate the need for trial runs. By minimizing the amount of inventory on the shop floor we will also prevent storage related problems. Because change overs are simplified and quicker it results in grater product throughput and higher machine utilization. Applying SMED and 5S tools the group reduce 65% of the manufacturing time changes in AMTROL-ALFA.

Keywords: SMED (Single Minute Exchange of Dies), Setup Time, A3 Process, 5S Methodology.

1 Introduction

The aim of Engineering and Industrial Management is to develop the ability to rationalize human, material, technical, economic and functional resources of a company in order to improve his overall performance.

One of the tools known by the Industrial Management Engineers to reduce waste, improving the performance of the company, is 5S, which corresponds to a methodology of creation and maintaining well organized, clean, high effective and high quality workplace.

Besides 5S, it is also known another tool that is very important to increase the performance of a company: SMED (Single-Minute of Exchange Die). This Lean tool is used to reduce machine changeover.

This project presents a research conducted by a group of six students of Industrial Engineering and Management (MIEGI) in University of Minho. It was in the PLE project (Project Led Education), held on the 4th year of the course that the undergraduate students were challenged to do this project. The PLE project is based on interdisciplinary problems based on a real situation, in order to help students to develop technical and soft skills.

The company where the group made his study during the first semester was AMTROL-ALFA. This company has his headquarters at Guimarães – Portugal.

AMTROL-ALFA produces different kinds of gas bottles to many different countries around the world.

Figure 1: International markets of the company

The assembly line studied in this article, produces three piece bottles like the bottle in the figure 2.

Figure 2: Gas Bottle produced in M3 line

The work station of the M3 line, where happens the manufacturing changes is responsible for the conformation of the metallic disks, that origins the chill. Before the conformation all the disks must be lubricate with oil. After that, half of the chills are drill.

On the first visit to the factory the engineer, that is responsible for the M3 line, told us that the big problem in the line was the long manufacturing time changes. One of the objectives of the company would make the change with a maximum duration of 45 minutes, which does not happen in some cases, as we can see in figure 3.

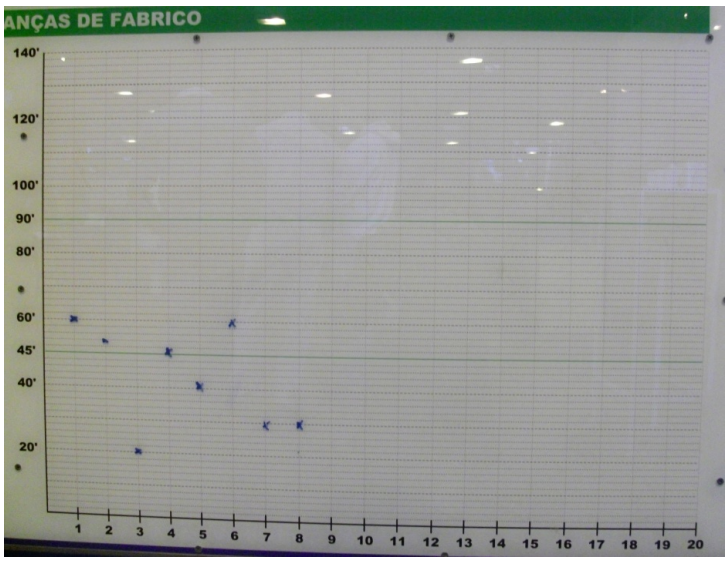

Figure 3: Board with the manufacturing time changes

Analyzing the figure it is possible to see that in 8 changes only half of them didn't past the company objective. It is possible to say that this problem is a big disadvantage for the company, for example, the promised lead time for the clients probably would delay, because the production planning and control of AMTROL-ALFA supposes that this change will take 45 minutes, in maximum, what is not true in reality. These delays are caused by the delaying of the production made by the high manufacturing time changes.

So, in order to solve this problematic, we will study the current methods used in the work station to make the manufacture change, study the environment around him and detect the unnecessary operation and movement that makes the setup time so elevated.

The studied made will try to reduce the setup time of the company and, in order to reduce the setup time it will be necessary different methods and lean manufacturing technics as we will see on the next chapter.

The present article is divided in 5 chapters. The first chapter, it is done the introduction of the work. On the second chapter, we can check the group analysis and the problem identification. The third chapter is presented the methodology used by the group. The principal results are shown on the forth chapter and finally the main conclusions are in the fifth chapter.

2 Company Analysis and Problem Identification

Being this our focus of analysis we decided to film a change of the manufacturing, with the support of a cam.

It should be said that the change in manufacture is performed by three workers. A worker that is responsible for the area, an operator responsible for handling the stacker and finally a worker at the time available to aid in transporting the support of the machine.

In order to make a careful study, it was drawn up a checklist. The total time was 54 minutes and 58 seconds.

It was found that to this high amount of time change of manufacture unnecessary delays exist, as can be seen on the red area from figure 3. In the figure it is possible to observe that in the time that there is a direct intervention of the operator responsible for running the change of manufacture, there is too long time waste to transport operations as we can observe on the yellow area.

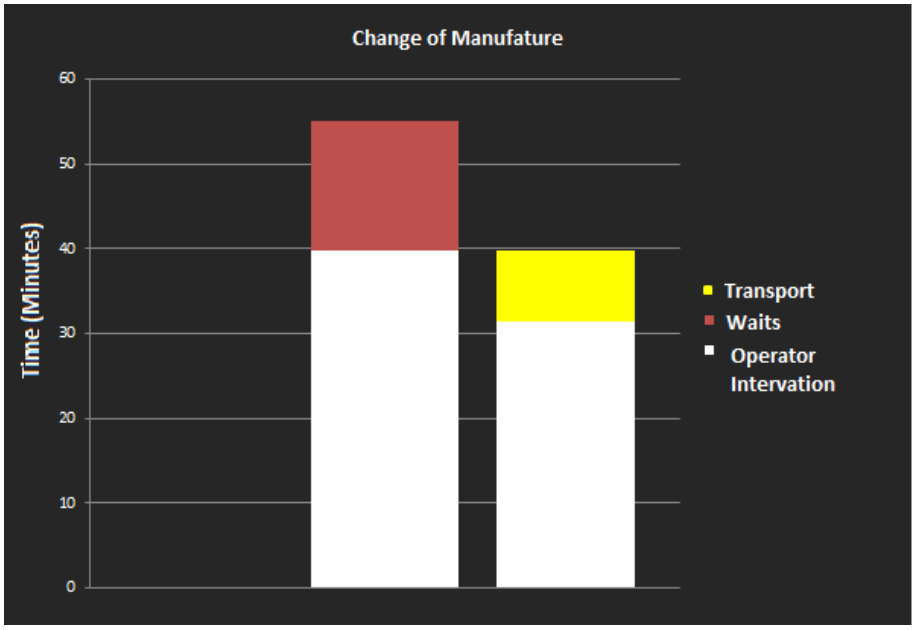

Figure 4: High amount of unnecessary delay

That said, it is found that the fact there has been a large change in time of manufacture would be due to:

- Lack of a procedure on how to do a change manufacturing;
- Absence of a near station to store the tools necessary to do change of manufacturing;
- Long time of transportation;
- Not having a immediately stacker available to do the change;
- Long time tuning and tightening screws

In order to describe the problematic studied in this scientific article we used the A3 Process.

3 Methodology

To solve this problem the group decided to apply a concept that is very important for industrial and management engineering: lean manufacturing. To be more specific we used SMED tool to approach the necessary tools and machines to do the manufacturing changes and used the 5S tool to clean and organize the station where those tools and machines should be.

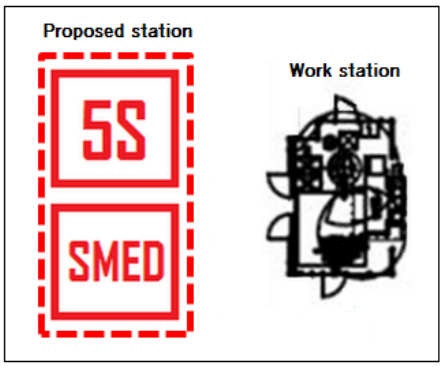

Figure 5: Lean Manufacturing in AMTROL-ALFA

By seeing the figure 5 is easy to see that the station that we want to propose to put the tools and machines to do the manufacturing changes is in front of the work station, where is done the manufacturing change.

3.1 SMED Methodology

To achieve high down times of change in the line currently practiced M3, was used SMED tool. One of the main difficulties met in this methodology is the identification and classification of operations. It was observed that there are operations that could be realized by the operator responsible for the machine while it was operating. With this, the group had separated from the operations considered internal setup of the operations of external setup for example search wrench or transport mold. This separation of the impact's setup is approximately 38.28 minutes. At this stage, it appears that there is a high operation time, which has direct intervention of the forklift, the solutions suggested for this are:

- A better planning of the forklift's operations, to reduce the operator's waiting in changing production.
- Forklift stated in the post.

There is also long times of transport operations. And the solutions are:

- Having a WorkStation in close proximity to the necessary tools, the support of the machine and mold present on the machine that will undergo the process of change, such as that put up the machine, the proximity of metal discs and also crucial.
- Perform the tool transport operation during the time that the machine is operating.
- To facilitate transport of the machine support, the bump metal should be remove.

Figure 6: Metal bump to be removed

Subsequently, the goal is to pass the internal setup to external setup. In this case is the cleaning operation, there is a total operating time waste of 2 minutes 52 seconds. One solution is:

- Creation of a cleaning system.
- To try to decrease the internal setup time values, the time of tightening and loosening screws (4 minutes and 13 seconds) must be reduced. Solutions to this problem are:
- Reduce the number of screws needed.
- Use of quick release screws

Operation performed by the operator responsible for the operator and available for transporting the machine support.

In short, there is a change of approximately 16.7 minutes. With the addition of washing system as external setup the manufacturing change time becomes approximately 13.83 minutes (13 minutes 50 seconds). This time of manufacture change may also be reduced if the worker who assists in transporting the support of the machine helps the operator responsible for the change of manufacture and the introduction of quick locking screws.

3.2 5S Methodology

As mentioned in the SMED technique for the proposal to reduce the transport time, you will need a work station closer to be a more effective storage of the tools necessary to change manufacturing, support the machine and mold, and finally the proximity of metal discs is also crucial.

There was a workstation that in the future may be used to do this as can be seen in the figure.

Figure 7: Areas in front of the Station 1

Applying this space 5S, first, it should be reorganized and identify materials which are important for the necessary change in manufacture. It is necessary to define the route to the ground which reduces the traveling times of the mold mark on the ground where the mold which will be replaced by the mold which is waiting. As was the case in SMED considerable time in the transport support will also be important to also allocate it and define your route to also decrease the time involved in this operation. Proceed with cleaning jobs as well as the surrounding area, in order to keep all layout cleaned, so that working conditions are the best. Finally, there is normalization of all cases.

4 Project Results

In table 1, it is possible to see the most important results that the group achieves. Analyzing the results, we can see a decrease of the operation time. Comparing the times of the actual situation with the times after the application of 5S and SMED, which optimize the mode how operations are done, is noticed a better use of time. The difference between both of the situation is 23 minutes and 27 seconds. Considering the conversion of external setup to internal setup is possible to reduce about 65% of the actual time.

Table 1: Project Results

	Actual Situation	SMED/5S	Diference
Getting the tools and molds	09:50	02:09	07:41
Waits (stacker)	11:28	00:00	11:28
Clean	02:52	00:00	02:52
Tightening and Loosening Screws	04:13	02:06	02:06
Summations	27:23	04:15	23:27

5 Conclusion

Regarding the main object of the project, we have mentioned lots of improvement proposal, thanks to the tool of lean manufacturing. It was applied the SMED tool to decrease the time of getting the tools and the machines to effectuate the manufacturing change by approaching the tools and machines in a station that is in front of the work station and organize the station by applying the 5S tool. In terms of results it was verified as reduction of 65% of the manufacturing time changes, which is very important for the company.

Concerning what the group as learnt on this project, the team wants to enhance one fundamental: not everything that is written on the theory corresponds to reality, in other words, the branch of engineering is not as objective as doing an exercise in a class room.

We felt some difficulties in applying the concepts due to the inexperience of the group.

To conclude this work, the group feels privileged to be within a project so enriching and confident for the future. It would be a proud for us, if AMTROL-ALFA uses the improvements proposed by the group. However, it is necessary to refute that this study should continue, to verify the efficiency of the proposed improvements and the costs that the proposals would lead to short or long time.

6 Acknowledgment

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