

Reducing Process Setup in a Smart TV Card Factory

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Abstract

Companies are looking for new ways to carry out their processes automatically and accurately. Thus, the machines that are part of the process need to be stopped, called setup, so that they are prepared to continue producing other products on the production line. This work was developed with the main objective of showing the effect of reducing the setup time in a television factory, and as specific objectives to present the concept of Fast Tool Change; present the negative effects of a production that has a lengthy setup; punctuate the benefits of reducing setup time in a factory. The methodology used is focused on exploratory research where it was necessary to visit the production line of a 32", 42", 50" and 55" Smart TV board manufacturing company, in order to apply the data collection instruments. To verify the failures resulting from the shutdowns and the problems that are related to the production setup time, quality tools such as Ishikawa Diagram, 5W2H and before and after study flowchart were used. As expected results, the company was able to reduce machine preparation delays, batch delays became minimal.

Keywords: Production; Setup Time Reduction;

1. Introduction

Globalization, market friendliness, and technological advances are increasing the demands of factories to increase their production, this market behavior forces companies to improve their processes as a means of reducing time to increase production efficiency, making it competitive in the market.

Thus, industries make efforts to reduce machine time to make production not stand still, and have no production delays or bottlenecks, so the shorter the machine's production time, the shorter the batch

produced and This impacts the processes.

Being aware of the relevance of reducing the setup time, this paper aims to highlight the effect of reducing the setup time in a television factory, and as specific objectives to present the concept of Quick Tool Change; present the negative effects of a production that has a lengthy setup; punctuate the benefits of reducing setup time in a factory.

As a methodology, an exploratory research was applied in a television factory of the Manaus industrial pole, where internal visits were made to find the bottlenecks that hinder the delivery time of the lot. The company in turn has been active in the market for over 10 years. And manufactures televisions of various brands, manufactures parts for models from 32 to 55 inches smart.

The justification of the work is around the time the company wastes with the setup time, and how much this procedure hinders the delivery of batches in a timely manner.

Given these characteristics, the guiding question arises: How can reducing setup time contribute to a plant's efficiency?

2. Theoretical Referential

2.1 Quick Tool Change - TRF

More and more companies need to look for new resources and skills to survive in the market. In general, the movement for more quality in processes and products, faster production and order fulfillment, and adequate price offer to the market without increasing manufacturing costs [1] is visible and constant. To meet customer demands, companies need to continually invest in concepts, techniques and tools that aim to improve their production systems, as well as methods that enable production flexibility and optimization of activities that do not add value to the final product.

One of the techniques that has changed thinking about production systems is Fast Tool Change (TRF) or Single Minute Exchange of Die (SMED). Viewed as one of the central elements in the implementation of lean production, the SMED system developed by Shigeo Shingo considers that any preparation time should be completed in less than ten minutes. Lean production is an integrated system that performs the production of products and services using the least costly inventory [2].

The history of the TRF or SMED system developed by Shigeo Shingo was based on three crucial experiences: the first in 1950, in the study of efficiency improvement at Mazda's Toyo Kogyo plant; later in 1957 at the Mitsubishi Shipbuilding shipyard located in Hiroshima; and in 1969, at Toyota Motors' main plant. These works have proven the impact on reducing setup time and improving overall activities.

Thus, the TRF system makes it possible to reduce setup times, making small batch production feasible, thus obtaining greater flexibility in introducing changes in product structure and faster responses to market changes. In addition, it provides a reduction in crossing times; reduction of inventory levels in process and finished products; cost reduction; reduction of worker efforts; reduction of errors due to machine adjustments and consequently reduction of defects and rework; and increased production capacity in critical resources [3].

2.2 Efficiency in the production process

This efficiency increase can be achieved by applying some tools or techniques. One way to increase efficiency is by reducing the machine setup time. Setup is a machine preparation activity before starting production of any product, but as long as it is not completed, the process remains stalled, thus inefficient [4].

Thus, setup is a typical example of waste with no added value and therefore should be reduced to the lowest possible value. Thus, the shorter the machine preparation time, the smaller the batch size produced, the higher the efficiency [5].

Setup is also known to be all the necessary tasks between when the last part of the previous batch has been completed and when the first part of the next batch is completed. Traditionally, the time involved in these tasks is long, which encourages production in larger batches, and consequently overproduction and increased waste.

Thus, the setup is classified into two basic categories of activities, defined by: internal and external. The routines that occur when the equipment is not in operation are those called internal, the activities performed while the equipment is working is called external. In practice it is possible to identify ways to reduce the time required to perform the setup, you can determine all process steps such as material preparation time for feeding and machine adjustment before starting operations for the next model [6]. Train the team that will provide all necessary activities before the start of the setup, and the knowledge of the type of equipment and the estimated time to perform the maneuver.

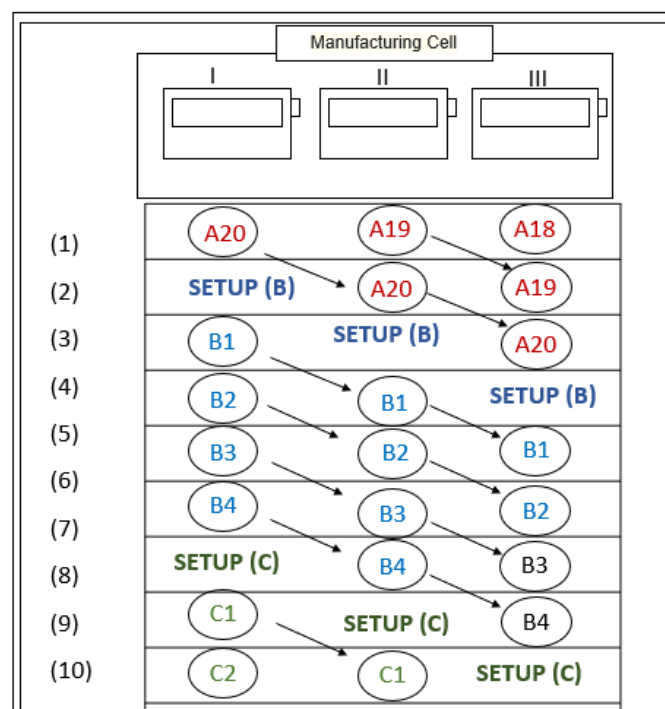


Figure 1: represents the production sequence and where setups are installed

Source: Jesus et al. (2018)

It is observed that the training of operators also contributes to reduce the total time that is used to perform the setup. Studying and balancing component distribution is an important factor in reducing waste and

improving the process. Updating programs also contributes to the reduction of setup time, thereby increasing the time available for production [6].

Linked to the production and process of SETUP, in an electronic board assembling company comes a series of assembly challenges that require a lot of knowledge of process, materials and physical and chemical phenomena related to the welding process. The main challenge of these companies is to assemble the electronic boards with maximum efficiency which means to have the minimum rework and to guarantee quality assemblies [7].

3. Methodology

The choice of the critical area of the company came from a visit to a television card factory, observatory research and data collection with interviewing of the production leader, for information on the history of previous stops so that could be done. stipulated the average time that the machines are stopped in the production of the plates; knowledge of the quantity required

For the accuracy of the information it was also necessary mappings focused on the process, to check the stops and the activities developed by the collaborators when the setups happen. Like participation in processes with cell phones and cameras to record information, observations were made preceded by notes of what was being seen in real time.

4. Applied Studies

The production line for the manufacture of slabs uses three types of machines: Panasonic CM602, Fuji NXT and Fuji XP. Where they are placed in cells for harmony and in accordance with regulatory standards involving contact with handlers. In order to find the flaws arising from the setup time, the quality tools were applied: Ishikawa diagram and 5W2H.

4.1 Problems Identified

With the application of the instruments of collection, interview and observation, it was possible to verify that the setup time varies from 50 min for the Panasonic CM602 machine; 45 min for the Fuji NXT machine; 60min for the Fuji XP machine, making production standstill for up to 1h for preparation. The time expected by the organization is up to 30 min. This causes some corrections to be made to reach this margin.

Another relevant factor, the number of employees for the activities is 18 employees, it was observed that while the machine is stopped some processes can be performed externally, external setup.

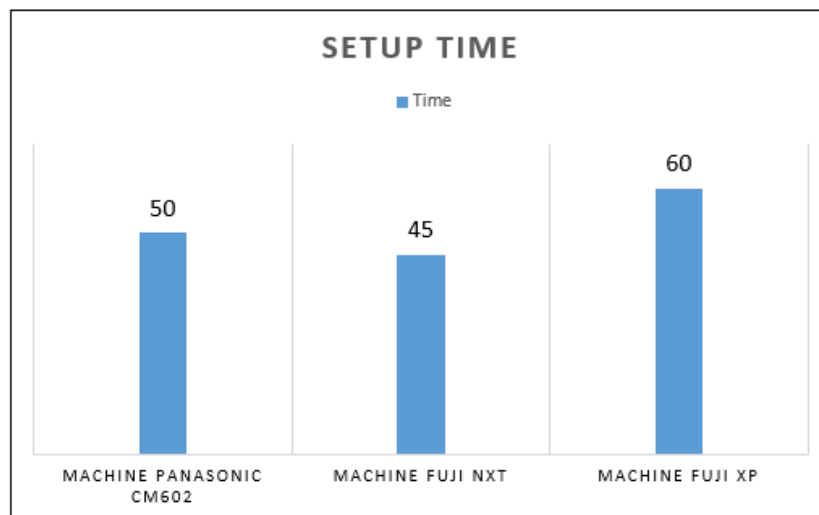


Figure 2 - Setup time with non-detailed timing

Source: author, 2019.

We considered past history of the time from which it was possible to average the time that was intended for the stops. It was observed that with the presence of observation the operators sought to perform their processes more efficiently for fear of being evaluated before their functions. Therefore, the time that was timed directly on the production line was influenced by the presence of observation.

The company has 2 shifts, where each shift consists of 08 hours. For the 32" and 42" TV cards the target of 194 cards per hour was set, 1,552 mounted per shift; for the 50" and 55" models it has a target of 178 per hour, 1,424 plates per shift. Based on the assumption that the 32" and 42" plates can be sold for R \$ 145.00 and the 50" and 55" plates for R \$ 210.00. Considering that each in turn, the machines have a stop where the maximum time is 60 minutes: the machine of the models of 32" and 42" stop producing 388 plates per day, leaving to produce 8,536 plates per month, losing about R \$ 1,237,720.00. For the other models of 50" and 55", it ceases to produce 356 per day, ceasing to produce 7,832 plates, ceasing to receive R \$ 1,644,720.00.

4.2 Ishikawa Diagram

When observing the factors that motivated the lengthy setup, it was found that the stops also happen to be made adjustments, these stops for adjustments are made due to the lack of knowledge about the possibility of the stoppage being only focused on preparation. The methods that are performed for mounting the boards do not take into account the activities that employees can do while in setup, thus performing an external or internal setup.

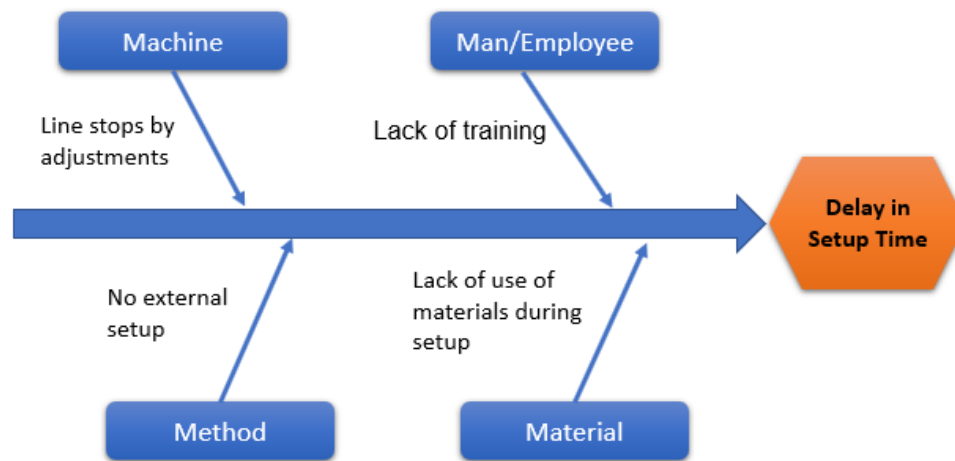


Figure 3 - Diagram of Causes and Effects

Source: Author, 2019.

It was observed that the delay of the setup time is being caused due to the lack of knowledge of the leader in using strategies aimed at taking advantage of the machine uptime. Thus, it also corroborates the lack of use of materials during setup, which could be external setup. It has also been found that the machine has adjustment stops along with setup intervals.

4.3 Action Plan - 5W2H

To develop a study aimed at reducing downtime, observations were made during production regarding the activities related to downtime of each machine. For this it was necessary to travel to the assembly line of the assembly of the components of the boards, having as responsible to guide the visit the leader. After that, it was necessary to divide what is internal activity from external activity. This divided the tasks that operators can continue to perform even with machine down. From these analyzes it was possible to develop the actions to be initiated to reduce the setup time in the factory, as shown in Table 1.

Table 1 - Action Plan

What	Why	Who	When	Where	How	How Much
Quick Setup and Tool Change Training - TRF	Increased knowledge by operators	Operators	15 days	In the company itself	In the company's own sector	R\$ 600,00
Separation of internal and external setup	Taking advantage of the stop	Operators	CM602 and Fuji XP Machine 1st Stop	Board Production Line	Standardization	Free
Assembly product preparation	Increase efficiency	Operators	Before the stops	Board Production Line	of activities;	Free

Source: Author, 2019.

5. Results and Discussions

The mappings performed in the production line allowed the analysis involving the procedures of the machine operators, where the time counts for the setups were performed. As a result, the proposal was created to separate activities that can be performed while the machine is running, which previously were only performed while the machine was idle. These activities involve leaving the materials to assemble the components separate while the plate is manufactured by the machines, making the internal setup to be external and thus reducing the time to stop separating the parts, as the parts will already be separated simultaneously. Relating to the settings, which also cause setups to occur. The suggestion turned to predictive maintenance, that is, an inspector can analyze the machines to predict the expected maintenance time, and then schedule activities, not allowing them to stop unnecessarily.

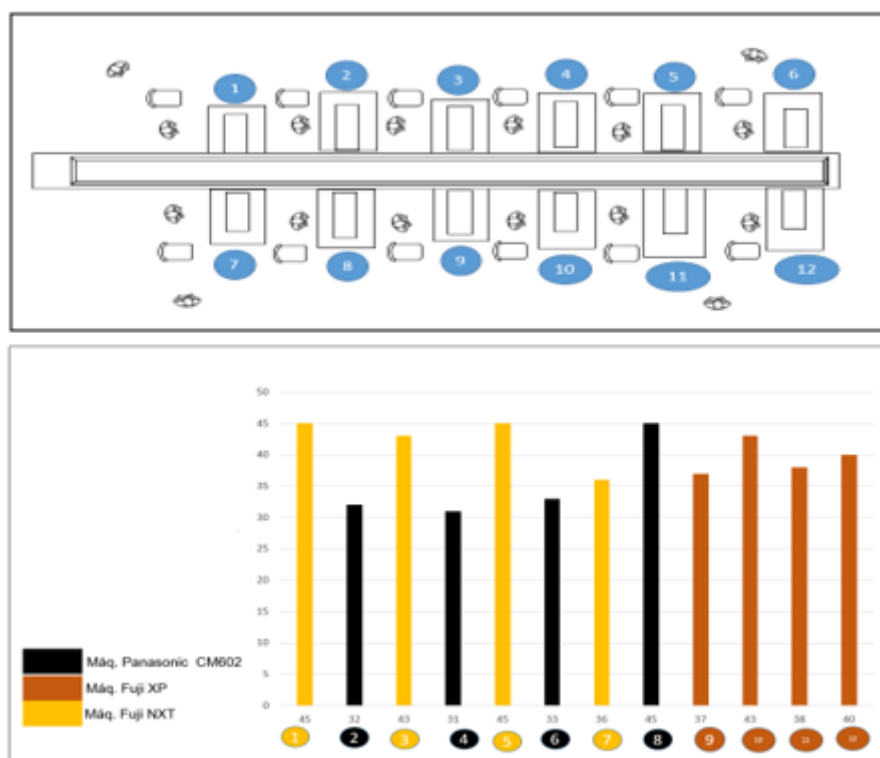


Figure 4 - Statement of timed minutes after proposal

Source: Author, 2019.

It can be observed according to figure 3 that after the implementation of the setup, where the suggested proposals were applied, there was a reduction regarding the setup time according to the machine model. On the Panasonic CM602 machine, which before the proposal had a history of 50 minutes on average after the proposal, with the insertion of the carts with parts to facilitate the operators, the time for this machine model on the line reduced to an average of 35 min., 30% reduction. For machines of the Fuji XP model, which previously had an average history of 60 min, after the changes presented an average of 39 min, a reduction of 35% of the time. For the other Fuji NXT model, the previous average was 45 min, after SMED implementation the setup time reduced to 42 min., It decreased by 6.67%.

The results were impacted by the degree of training and involvement of the operator with the result, it was

found that the operators of the machines CM602 and XP showed more relevant results from the presence of observers regarding the procedures performed during production. In contrast, the results were lower when operators performed the activities without the presence of an observer on the production line, because the result was determined by information from the machine itself.

Thus, it is known that what makes the setup time longer is the employee's participation so that the procedures are more efficient and can corroborate the economic and financial impacts of the company. In order for the procedures to be performed successfully, the leader must set a time target and be responsible for verifying that the operators are being quick and wasting time, causing the setups to become external in their most.

Adjustments that caused machine shutdowns were now scheduled, making it possible to use efficient mechanisms with the application of SMED to make the preparation time on average 30 minutes. Future studies need to be applied to the 9 minute time range to make the company's losses as small as possible.

6. Final Considerations

The setup of a machine is considered a downtime to prepare for the manufacture of a new product. However, with research into the production of a TV card manufacturing company, it was possible to understand that downtime can be reversed, and activities that were only performed with downtime machines can be done while the machine is running. shutdown to perform a particular procedure. Including a cart with parts to assemble the board while machines are manufacturing also makes operators productive simultaneously with the machines. By reducing machine time, the company can recover from the economic loss it suffers when each machine stops producing over 40 minutes.

Thus, the values that could be produced at this time become smaller than those with the average of 60 minutes. As a result, economic and financial losses from sales projections become smaller, making time better spent.

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