

Improvement of Change Over Time of Cage Press Machine in Bearing Production at PT. XYZ Using the SMED Method

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Article Information	ABSTRACT
Article History Received : March 20, 2025 Revised : April 03, 2025 Published : April 12, 2025	PT. XYZ is a manufacturing company with its production, namely bearings, both from small to large sizes. The growth of bearing sales interest is increasing every year, therefore PT XYZ must be able to adjust to the needs of consumers. This causes many types of bearings that must be produced by PT XYZ, this type change affects the time in the machine change over process. This research was carried out with the aim of reducing the time used for the machine change over process, especially on the chage press machine which has been seen through patchwok data. The improvements made are by using the PDCA and SMED methods, to be able to find out what factors are the cause of the long change over and also how to reduce the time in the change over process of the machine, With the implementation of SMED PT. XYZ managed to reduce the time from 1 hour 9 minutes 56 seconds to 9 minutes 1 second with a time reduction of 1 hour 55 seconds or equivalent to 87.85%. Thus, this SMED method can be used to improve engine change time to make it faster.
Keywords: <i>Change over; Single Minute Exchange of Die; Plan-Do-Check-Act.</i>	

INTRODUCTION

SMED is one of the improvement methods of Lean Manufacturing that is used to accelerate the time needed to do Setup the transition from producing one type of product to another. The SMED method is one of the preparation/preparation tools to reduce waste (Waste) by separating the internal time of preparation or Change over and external Preparation or Change over time. Change over defined as the length of time it takes to make a product change and setup The machine starts from the last product finished production until the first new product starts to be produced again. So that when production is very diverse, Change over often happens. Therefore, it must be eliminated or at least lowered to a minimum (Studi et al., 2024). PT XYZ, as one of the leading bearing manufacturers, relies heavily on advanced machines to support its production process. Bearings, also known as bearings, are important components in machinery that function to reduce friction between two moving parts, as well as direct the movement as desired.

With the many types of bearings available, the machines used in the production process are modified to operate several types. So that this makes the machine experience tooling changes due to type changes. Tooling change on a machine is also called a machine change over, machine change is the process of changing from one type of production to another type of production on a production machine. According to Terry Wireman, change over is the process of changing between two or more batches of products on a tool or line with the aim of improving productivity and flexibility. In machine change over, it takes time to release the tools used in the previous type,

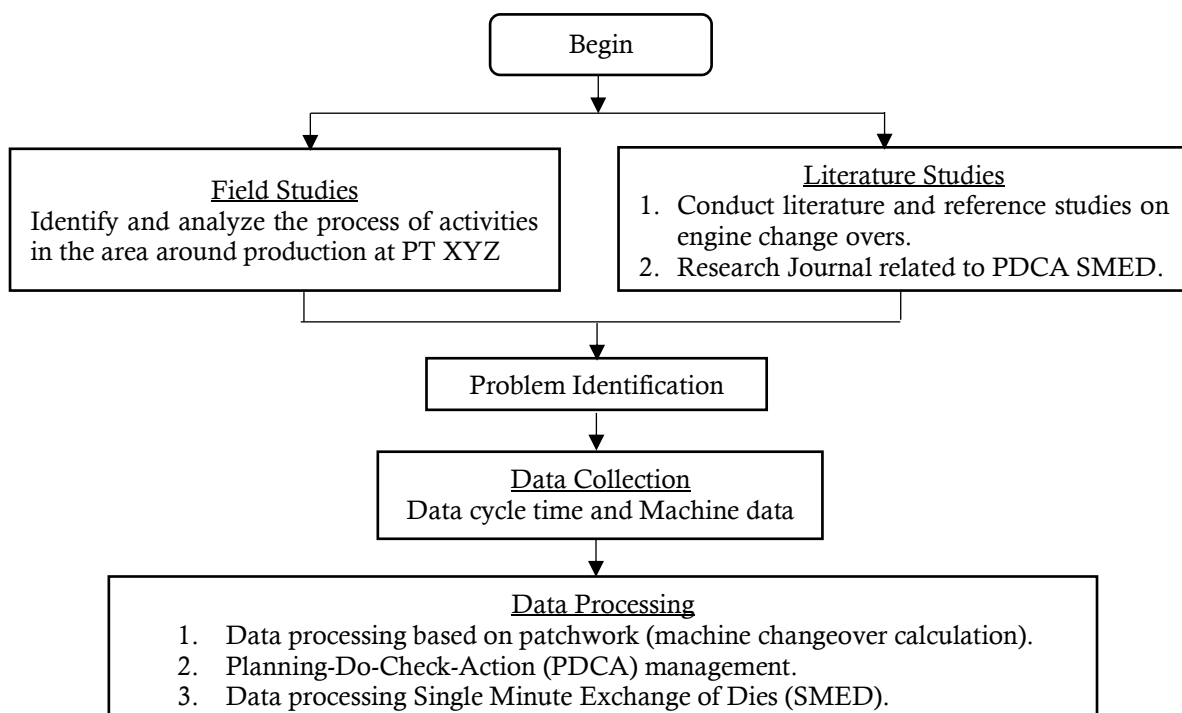
then replace it by installing the tools needed by the machine for the next type that will operate. In the process of changover the machine, it takes a lot of time, so it can affect the operational activities at PT XYZ. Therefore, improvements are needed to the engine change over process so that it can be shortened.

From the above constraints, one of the efforts that can be made is to reduce the time needed when changing over machines in order to increase production achievements. Improving the change over time can be done by reducing unnecessary activities on the machine. Reducing the change over time can be done by the Plan-Do-Check-Action (PDCA) method and also Single Minute Exchanges Of Dies (SMED). PDCA is a problem-solving process that has four literary steps that are commonly used in quality control.

The SMED method has also been proven to be successfully applied to shorten the time to replace the dies in many companies such as PT Phapros Tbk, the result of the initial setup time of 80.91 minutes and the setup time after using the SMED method was reduced to 65.36 minutes. With a percentage reduction in setup time of 19.22%. This can show that the SMED method can be used to speed up machine setup time (Chandra Setiawan, 2023). As for PT. GPs who applied the SMED method in their studies resulted in a reduction in setup time by 26% or 16 minutes (Arief & Ikatrinasari, 2019). For this reason, this study was carried out to reduce the long engine changeover time using PDCA and SMED methods.

RESEARCH METHODS

This study employs both quantitative and qualitative research with a case study approach. the methods used, namely the PDCA method and the SMED method. PDCA is a problem-solving process that has four literary steps that are commonly used in quality control. This method was popularized by W. Edwards Deming, the father of modern quality control, so it is often referred to as the Deming cycle (Dian, 2019). Meanwhile, SMED is one of the improvement methods of lean manufacturing that is used to accelerate the time needed to make a change setup from producing one type of product to another product model. Replacement setup time is a form of waste in the lean concept that must be eliminated because it does not add value to customers and results in inefficient processes (Studi et al., 2021). The stages of the research carried out can be seen in figure 1 as follows.



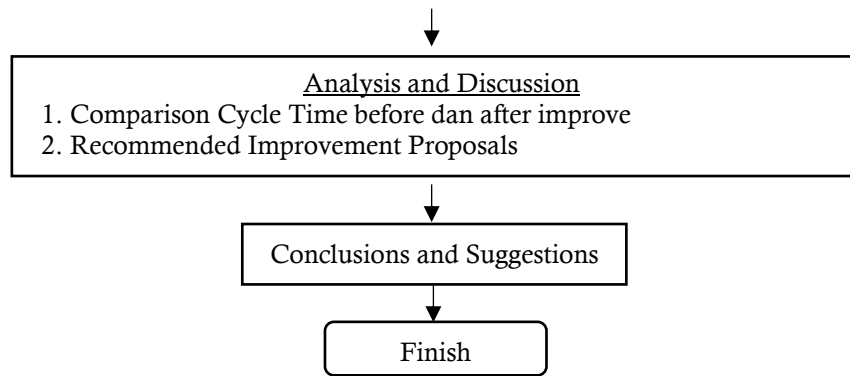


Figure 1. Research Stage

RESULTS AND DISCUSSION

To record machine change over activities, pathwork is used as a recording medium for the time used to perform machine change overs. This data is obtained at the time of the change over, and the recording is done every 10 minutes. The following is the patchwork data for February and March 2024 in Figure 1 and Figure 2:

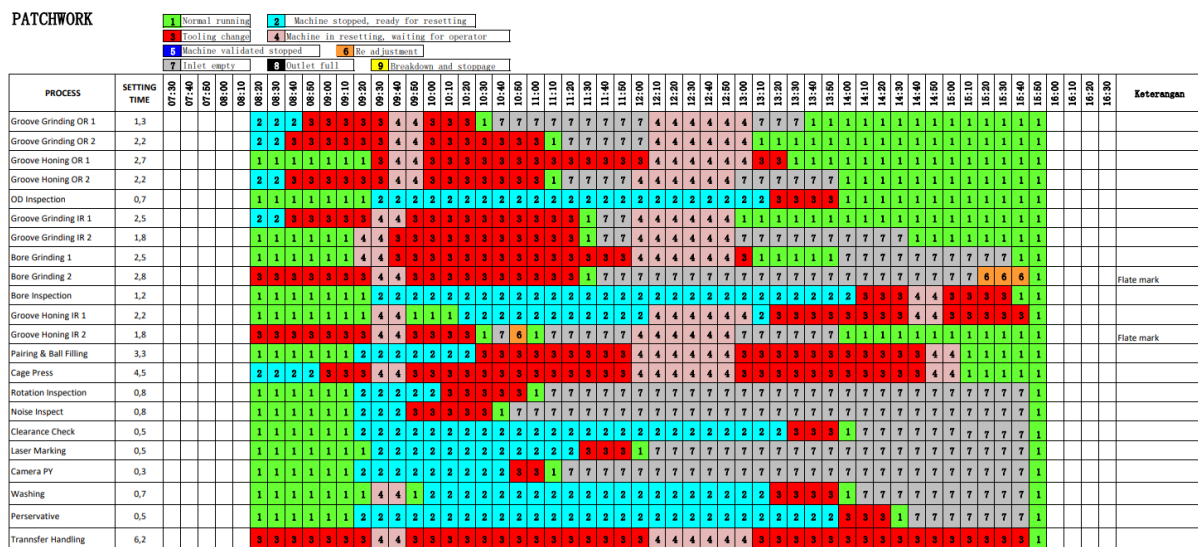


Figure 2. Patchwork Data February 2024

PATCHWORK

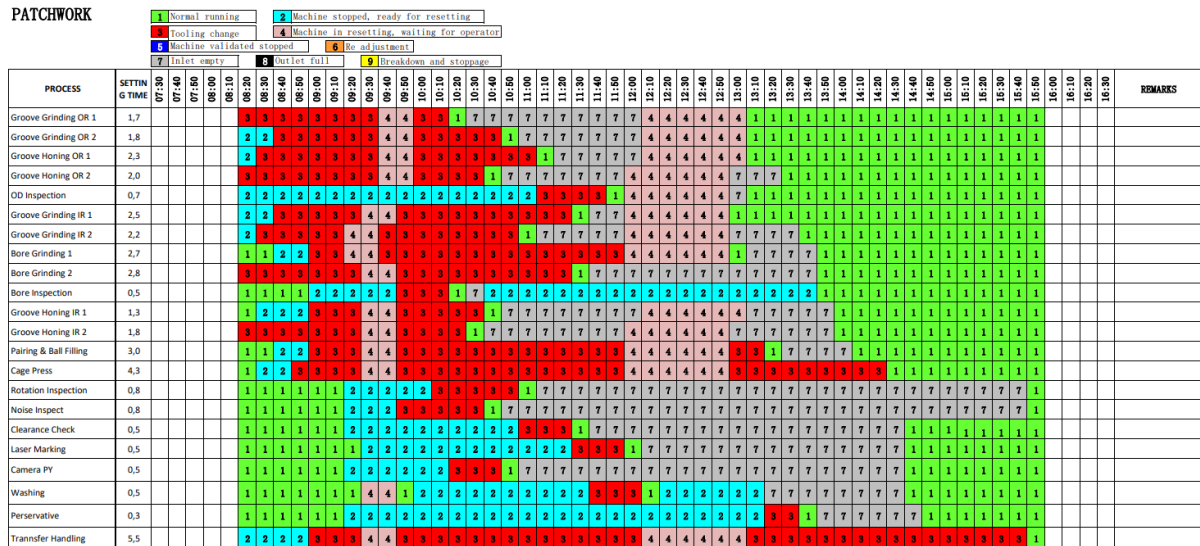


Figure 3. Patchwork Data March 2024

Plan

This stage aims to analyze the main causes of existing problems. In this study, the first step was to find out which machine had the longest change over process.

To determine which machine will be improved, it is necessary to collect data using pathwork as previously explained, therefore to make it easier for the pathwork data that has been obtained to be made into graphs such as Figure 3 and Figure 4 as follows:

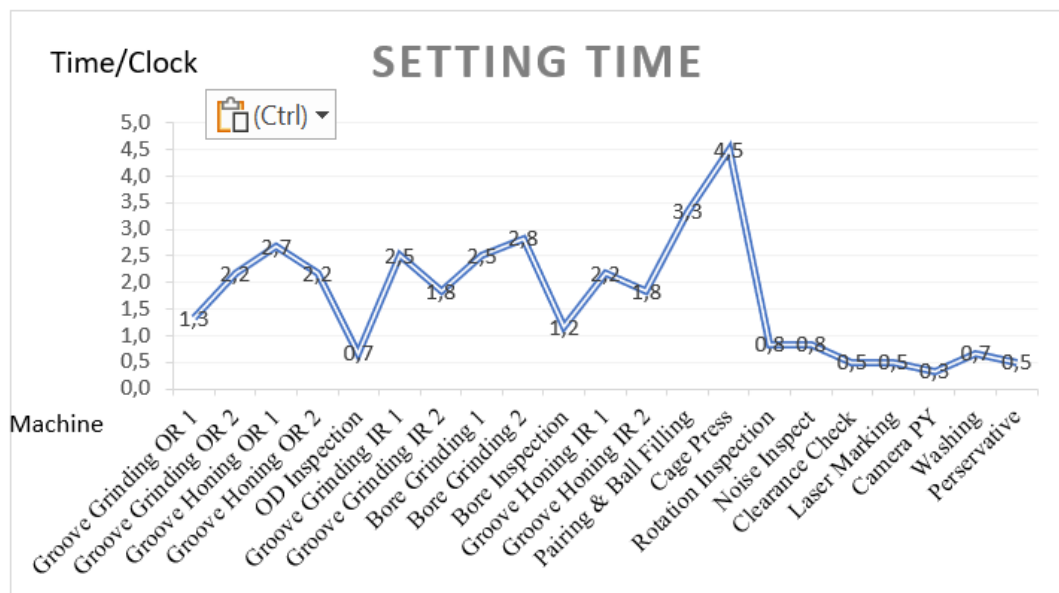


Figure 4. Grafik Change over February 2024

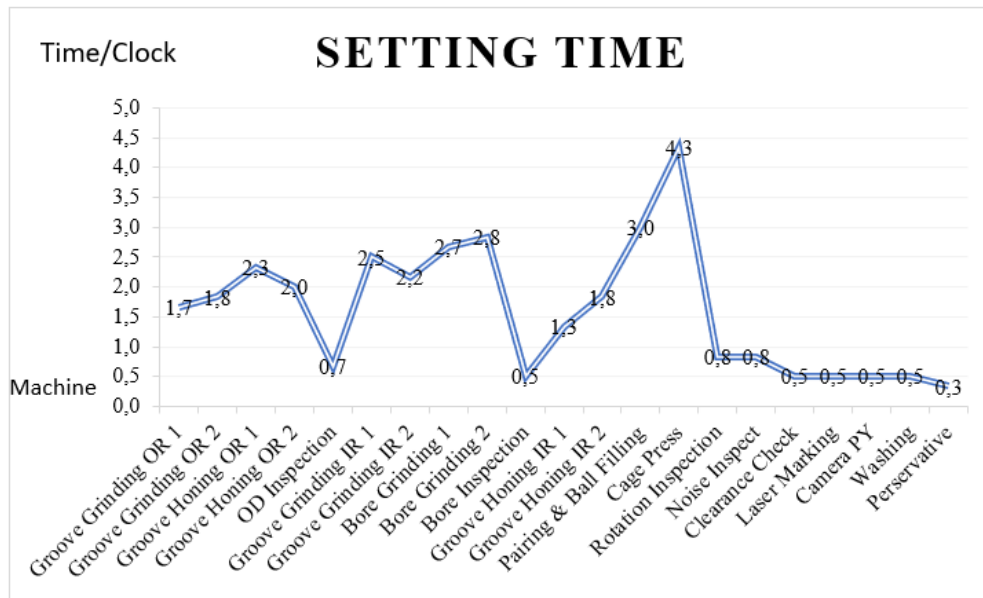


Figure 5. Grafik Change over March 2024

Based on the observation results in figures 3 and 4, the longest change over time is in the cage press machine. To find out more about the factors that cause the cage press machine to take a long time in the engine change over process, a fishbone diagram is made as shown in Figure 5 as follows.

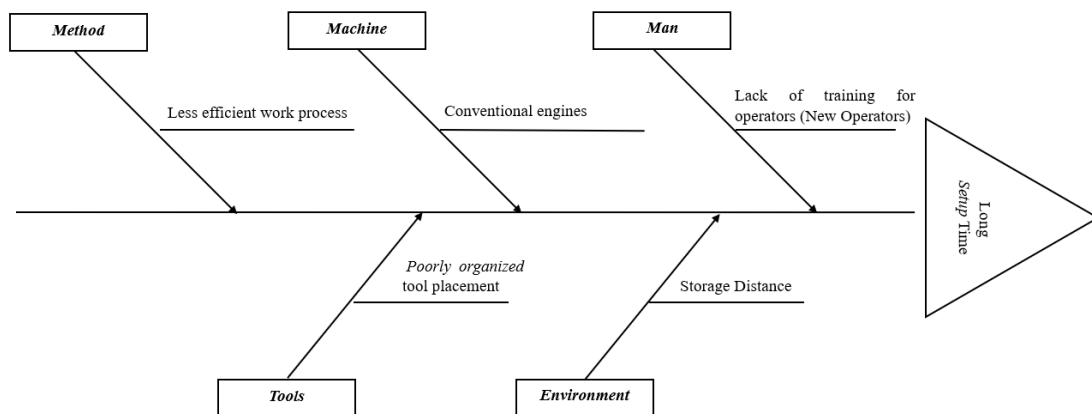


Figure 6. Fishbone Diagram

By using a fishbone diagram, it can be known that the factors of machine change over are long, be it from human factors, machines, methods, the environment or tools and equipment at the time the machine change over is carried out. The following is the result of the identification of the fishbone diagram.

1. Storage distance
2. Less significant tool placement
3. Inefficient work processes
4. Lack of training for new operators

The proposed improvement of the factors in the *fishbone diagram* can be seen in table 1:

Table 1. Proposed Improvements Change Machine

No	Root Cause	Proposed Improvements				
		What	Who	Why	How	How about the risk
1	New operators lack adequate training	Conducting training	Operator, Engineering	So that they stay up to date with the latest procedures and techniques.	Conducting regular training for new operators and refresher training for existing operators	Additional costs for training, potential downtime during training sessions, and resistance from legacy operators to changes in procedures.
2	The storage distance of the tool or material is too far from the work area	Putting tools or materials closer together	Operator, Engineering	So that it doesn't take much time to	- Customize storage layouts to make them closer and more accessible - Reduce movement barriers in the work area	The risk of layout changes disrupting workflows temporarily, as well as the potential for additional investment in new shelves or storage bays.
3	Slow engine response time	Machine maintenance	Maintenance	To keep the engine healthy and able to operate properly	Engine maintenance is carried out regularly to maintain performance	Additional costs for routine maintenance, the possibility of temporary downtime during maintenance, as well as the need for additional resources for periodic inspections.
4	Unorganized tool placement	Creating a shadow board	engineering	To make it easier to pick up the tool	- Shadow board is used to store tools with fixed locations. - Implementation of 5S to increase order and efficiency. - Checklist the tool before setup to ensure completeness.	It takes time to rearrange the layout of the tool storage, the initial investment in the creation of shadow boards, as well as the possibility of resistance from workers to new habits.

5	Less efficient work process	Making improvements to the work process	Engineering	In order to minimize ineffective work processes	Applying the SMED method to the <i>change over process</i>	The risk of production disruption during the implementation of the change, requires additional training for workers, as well as initial investment in new tools or systems to support the SMED method.
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Do

Based on the analysis above, what causes the length of machine change over is an inefficient work process, therefore improvements are needed in machine change over activities. The engine change over activities before the improvement are made can be seen in the following table 2.

Table 2. Proses Change over Mesin Cage Press

No	Activities	Time
1	Press the cycle stop button and then turn the switch in the manual direction	00:02:12
2	Remove the 6 bottom dies on the rotary table	00:05:20
3	Remove the lower magazine unit by removing the sensor and air hose before	00:06:15
4	Remove the Press I Unit	00:05:56
5	Remove the Press II Unit	00:04:58
6	Release the Final Inspection Unit	00:08:10
7	Open the driving plate	00:07:25
8	Remove the upper dispenser	00:08:15
9	Remove the Griper	00:03:22
10	Removing the bottom driver plate	00:04:40
11	Remove the top driver plate	00:02:14
12	Remove the spacing plate	00:03:24
13	Remove the Rotating Plate	00:03:10
14	Release and let chute	00:04:34
15	Remove Ball Divider Plate	00:07:55
16	Remove the BC gripper ok	00:03:12
17	Install 6 dies on the rotary table	00:02:45
18	Prepare Housing of Final Inspection	00:02:40
19	Install all pin of Final Inspection	00:34:09
20	Install final inspection unit assy to station	00:04:11
21	Check the connections of all pin according to the number of rivets of the bearing to be set	00:28:56
22	Removing the bottom driver plate	00:03:48
23	Releasing the lower magazine	00:04:52
24	The top driver plate	00:06:15
25	Removing the rotating plate	00:08:58
26	Removing the spacing plate	00:05:08
27	Pass ball divider plate	00:08:42
28	Releasing in late touch	00:07:10
29	Pass upper magazine	00:06:15
30	Passover gripper	00:06:36

31	Install the pick up finger on the unloader device	00:05:22
32	Place the bearing without cav on the rotating plate	00:04:15
33	Select the menu on the ball dividing screen display (F 14)	00:03:45
34	Press the manual confirm button and stop the forward at the same time repeatedly, step by step the engine will	00:05:15
SUM		03:50:04

The implementation of improvements in the cage press machine change over process was carried out in the 18th to 21st activities, the results of the scattered improvements can be seen in the Figure 6 as follows.

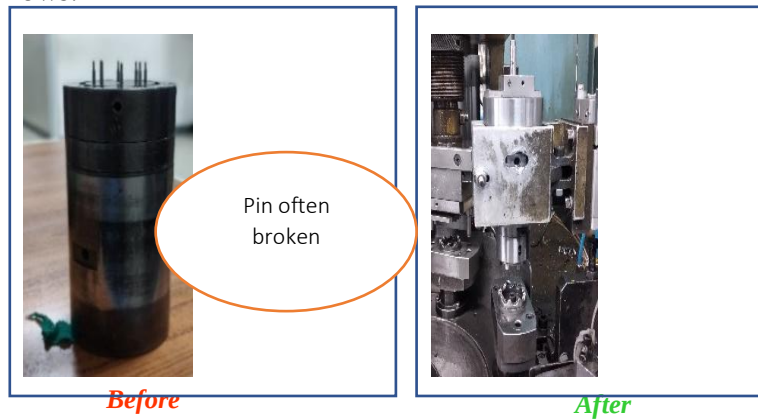


Figure 7. Before and After Improvement

Before the improvement of rivet height measurement using pins, the problem that occurred was that the final inspection pin often broke and took about 30-60 minutes to repair. Therefore, improvements were made to get the results of the final inspection design changed from the one that originally used pins to dies so that they were stronger and problems did not occur often. The benefits of the improvement results carried out are: 1) No downtime due to broken pins; 2) Improved lifetime end checks; and 3) The resetting process is easier because there is no need to remove the entire unit

Check

The inspection stage of the results of the repairs that have been carried out is by re-recording the change over process on the cage press machine using patchwork. From this patchwork data, you will see the difference before the improvement is made and after an improvement is made. Therefore, a comparison will be obtained as shown in figure 7 as follows.

No	CURRENT/PROPOSED METHOD DETAILS	Time Taken	Remark	Improve				IDEAS	Status	Time Taken after Improvement
				Eliminate	Combine	Rearrange	Simplify			
18	Prepare housing of final inspection	00:02:40						Purchase 1 type 1 unit	Done	00:01:20
19	Install all pin of final inspection	00:34:09	Wasting time for install the all pin					Prepare 1 unit assy from presett	Done	00:00:00
20	Install final inspection unit assy to station	00:04:11						Install final inspection unit assy to station	Done	00:03:10
21	Check the connections of all pin according to the number of rivets of the bearing to be set	00:28:56	Measuring the height of the rivet using a pin, the problem that occurs is that the final inspection pin often breaks and takes around 30-60 minutes to repair.					After improvement new methode / SMED, final inspection unit not breakdown / not broken again	Done	00:04:31

Figure 7. Before and After Repair Time

Action

After making several improvements to the cage press machine change over process, it has been known that the factors that cause the long engine change over process at PT XYZ can be minimized. To maintain the results of these improvements, the company has established standards such as:

1. Recording time during the change over process is done using patchwork
2. Creating a Shadow board is used to store tools with a fixed location.
3. Customize storage layouts to make them closer and more accessible.

CONCLUSION

From the results of this study, it can be concluded that improvements made are using the PDCA (Plan-Do-Check-Action) method and the SMED (Single-Minute Exchange of Dies) method through improvements in the cage press machine change over process, namely by elimination, combination, rearrangement and also simplification, then the results of reducing the time in the bearing machine change over process are obtained. The cage press machine is 1 hour 55 seconds or equivalent to 87.85%. With the initial details before the repair was made, which took 1 hour 9 minutes 56 seconds, now it only takes 9 minutes and 1 second in the process.

The practical implications of implementing SMED integrated in the PDCA cycle are Changeover Time Efficiency. The reduction of machine changeover time has a direct impact on the increase of machine operating time. Furthermore, namely increasing productivity, reducing downtime when changing product types makes the number of daily production batches increase without increasing working hours. As well as Reduction of Production Costs, where with reduced setup time, there will be a decrease in the frequency of overtime and labor waste, so that production costs decrease.

There are several suggestions aimed at companies and for future research: Improving human resources by providing job training, as well as providing directions to carry out the machine changeover process. And conducting research on other machines either using the same or different methods, so that the engine choneover process becomes more efficient.

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