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TABLE OF CONTENTS

ERGONOMIC AND HUMAN FACTORS

PRODUCTION AND OPERATION MANAGEMENT

CYBER SECURITY AND ARTIFICIAL INTELLIGENCE

SOFTWARE ENGINEERING

AUTOMATION, MECHATRONICS AND ROBOTICS

LOGISTICS AND SUPPLY CHAIN

SUSTAINABLE ENERGY AND ENVIRONMENT

Implementation of Single Minute Exchange of Dies at PT Ganding Toolsindo

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ABSTRACT

PT Ganding Toolsindo's problem is the replacement of the die which takes a long time, around 30 to 45 minutes per setup. The strategy that can be used to reduce setup time is to apply the Single Minute Exchange of Dies (SMED) method. This research aims to identify the cause of the high die replacement time on the SEYI SN2-300 Press Machine and take corrective steps to increase production effectiveness on the machine, as well as design jigs and fixtures that can make it easier for operators to replace the die. Results Based on data collection on setup dies activity on the SEYI SN2-300 Press Machine, all entered into the internal setup activity with a duration of 2144 seconds. Changes from an internal setup to an external setup have been made. Changing from internal setup to external setup can reduce downtime by 369 seconds. The design of the tools in the form of hanging rollers and roller die is expected to reduce the machine's internal setup time, where these tools can assist operators in moving old dies and installing new dies into the press machine. Based on the measurement of setup time after the implementation of the tools made, the results showed that there was a decrease in setup time of 331 seconds or 5.52 minutes..

CCS CONCEPTS

• **General and reference** → Document types; Reference works.

KEYWORDS

die replacement, single-minute exchange of dies, jig, and fixture design

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1 INTRODUCTION

The increasingly fierce level of competition in the industry requires companies to have competitive advantages, such as higher quality products and faster service. Companies that can satisfy their customers with faster and quality product delivery will have an advantage over their competitors. Faster service can be done by optimizing value value-added and minimizing non-value-added activities.

PT Ganding Toolsindo is an automotive component manufacturing company that was founded in 1998 by Ir. H. Wan Fauzi. The company develops in the manufacture of machine parts, stamping parts, assembly parts, molds, and dies, as well as fixtures and jigs. PT Ganding Toolsindo is faced with a competitive lead time challenge. The problem faced by the company is that there are still non-value-added activities such as death reimbursement which takes a long time around 30 to 45 minutes per setup. The process of replacing the die can reach 3 (three) times.

One approach that can be taken to reduce setup time is to apply the Single Minute Exchange of Dies (SMED) method. This concept was introduced by Shingo in 1960 which was a strategy to speed up die replacement setup [1]. The application of this method can reduce setup time in various industries. This study aims to identify the cause of the dead repair time on the SEYI SN2-300 Press Machine and take the following steps to increase production effectiveness on these machines, through the implementation of SMED, as well as the design of tools that can make it easier for operators to carry out the die replacement process

2 LITERATURE REVIEW

Lean is an effort that is made continuously to eliminate waste and increase the added value of products (goods or services) to provide value to customers (customer value) so that it is appropriate to achieve a perfect work flow to minimize waste and be flexible or change the process [2]

In the Lean approach there are five principles [3]:

1. Identify what provides value and what does not from the customer's point of view and not from the perspective of the organization, function, or department.

2. Identify the steps required to design, order, and produce along the value-added process for the wastage flow. 3. Make value-added activities flow without distractions, flipping, or waiting.

4. Make what the customer only asks for.

5. Striving for perfection continuously reduces wastage.

The latest research that focuses on the implementation of SMED, among others, is Mulyana and Hasibuan [4] proving that the application of the SMED method in the process of setup or changeover

activities in the production of telecommunication panels has reduced the downtime of punching machines from 44.90 hours to 10.96 hours or a decrease in time of 75.59%. The SMED method is applied to the Palestinian Aluminum Profile Company to reduce the time of dies changing when manufacturing aluminum profiles. The results show that the implementation of SMED can result in savings ranging from 5%-15% in running costs while increasing production capacity [5].

Implementation of the Single Minute Exchange of Dies (SMED) and Maynard Operation Sequence Technique (MOST) Methods for Improvements has been carried out at PT. X Surabaya to improve the production process time. The SMED method is applied at the setup time of changing the production of one type of model to another. The result of applying the SMED method is a reduction in setup time from 3410 seconds to 2627 seconds or 43.5%. While the MOST (Maynard Operation Sequence Technology) method is used to measure based on the order of the sub-activity or movement. Improvements made include inventory area made with line 2 area so that it can take 780 TMU, laying material so that time can be eliminated by 1920 TMU, placing shrink package so that it can increase the time by 960 TMU [6].

Reducing dies replacement time on the 75-ton Nouguchi press machine was carried out at PT. Implement Prosperous Engineering. The method used is the SMED (Single Minutes Exchange of Die) method. Improvements were made to overcome the problem of handling dies from the storage area to the machine area which has a longer distance. The stages of improvement carried out are improving work procedures and designing trolley die tools. The reduction in time obtained after the repair process is 30% or 571 from the initial time of 1885 seconds to 1314 seconds. The reduction in time is expected to increase the effectiveness of production at PT. Laksana Teknik Makmur [7].

Another study on the use of the SMED method in the metal-working industry was conducted by Monteiro, et al. This research aims to reduce waste and increase productivity in the machining department. The steps taken are problems and processes using flow charts and VSM (Value Stream Mapping). The improvements made succeeded in reducing setup time by 40% on vertical milling machines and 57% on horizontal milling machines[8].

The SMED method can also be applied to the pharmaceutical industry to improve output quality and customer satisfaction. The results showed that the application of the SMED method can shorten machine downtime so that production capacity increases. Time reduction from the application of the SMED method by 30% within 12 months [9].

Another alternative to reduce setup time is to use a jig and fixture. The use of jigs & fixtures makes it easier to work on the manufacturing process to get higher product quality or higher production rates [10]. In designing jigs and fixtures, things need to be considered, including convenience, security and user comfort, and the process of making the materials used [11].

3 RESEARCH METHODOLOGY

The research method used is direct observation in the field. During the dies replacement process, recording is carried out so that the operator's time and activity data can be known from the recorded video. The implementation of SMED starts from the identification of the internal setup activities and the external setup activities in the washer component production process 1. The stages of the research process can be seen in Figure 1.

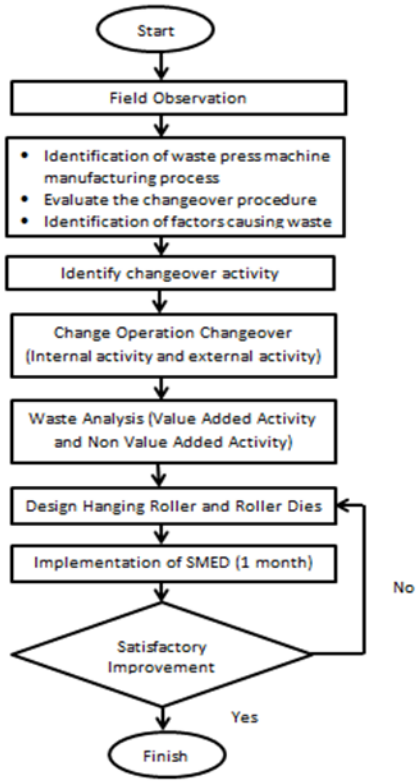

Figure 1: Stages of the Research Process

4 FINDING AND DISCUSSION

4.1 Setup Time Calculation

Field observations were carried out by observing the activity of replacing dies. Measurement of the time required for each machine setup activity by going through the video recording of the SEYI SN2-300 Press Machine setup activity. Based on the measurement results of the setup process, the total time required to setup dies on the SEYI SN2-300 Press Machine is 2144 seconds or 35.73 minutes.

4.2 Identification of Internal Setup and External Setup Activity

The internal setup activity is a dies replacement activity carried out by stopping the machine/process and checking the first product, while the external setup activity is a setup activity carried out without stopping the machine (initial preparation and completion). Identification of the activities of the internal setup and external setup can be seen in Table 1.

Based on field observations, all die setup processes carried out on press machines are carried out in a machine stopped condition so that 100% of setup activities are included in the downtime category,

Table 1: Identification of Internal Setup and External Setup Activity

No	Activity	Type	Time (s)
1	Lowering upper dies	Internal	6
2	Removing the bolt	Internal	107
3	Raising the upper engine base	Internal	14
4	Cleaning the press machine area	Internal	132
5	Waiting for the forklift	Internal	42
6	Lifting dies	Internal	14
7	Block the dies	Internal	4
8	Moving the dies to the dies storage	Internal	61
9	Taking new dies for the stamping washer 1 process using a crane	Internal	80
10	Lifting the dies to the press machine by using a forklift	Internal	94
11	Set the top base height	Internal	239
12	Fixing bolts for fastening the dies on the machine	Internal	654
13	Make sure the dies are set properly	Internal	27
14	Taking material for stamping washer components 1	Internal	161
15	Installing the material from the washer 1 component to the coil feeder machine	Internal	41
16	Attaching the material to the coil feeder machine to the press	Internal	74
17	Place the reservoir for the remaining pieces of production material (scrap)	Internal	26
18	Putting the base and the power button	Internal	18
19	Conduct trial production and check the quality of washer components 1	Internal	350

where total downtime = total setup time is 35.73 minutes. In 1 day there are 3 (three) die setup activities, so the total dies setup time is 3 x 35.73 minutes = 107.19 minutes/day and the whole process is an internal setup which will be downtime for the company, which is 1, 79 hours/day. While the time required to produce 1 unit of washer 1 component, where the process takes 1 stroke is 2 seconds, then if the loss experienced by the company is 107.19 minutes/day or 6431.4 seconds/unit divided by processing time 1 washer is 2 seconds/unit, so the result is 3215.7 or about 3215 units which will be lost because that time is the time when the machine is stopped.

4.3 Change of Internal Setup Activity to External Setup Activity

Changing the internal setup activity to an external setup activity requires improvements to the system and the way the operator works. With these changes, it is hoped that some internal setup activities can be carried out while the machine is still operating or turned into an external setup. Changes in internal activity to external setup can be seen in Table 2.

In Table 2, it can be seen that there are changes in some of the internal setup activities to become external setups according to the observation of the die replacement activity on the SEYI SN2-300 Press Machine so that the downtime on the SEYI SN2-300 Press Machine is reduced by 369 seconds, so the current downtime is 1775 seconds with a downtime percentage of 82.79%.

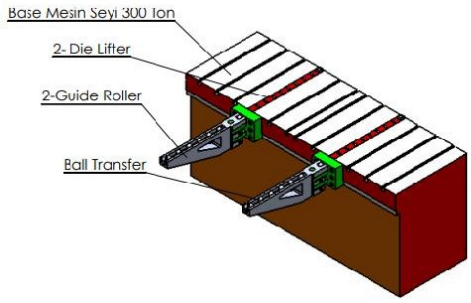

Figure 2: Hanging Roller Design

4.4 Analysis of The Causes of High Internal Set-up Activity

Analysis of the factors causing high machine down time and internal setup activity time using the 5W+1H method as shown in Table 3.

4.5 Reduce the time of internal activity setup

To assist the process of moving the old dies to the dies storage area and transferring the new dies to the press machine, work aids were designed in the form of hanging rollers and roller dies which can be seen in Figure 2.

Figure 2 is a design drawing of the hanging roller tool. This tool is made of iron with a roller in the middle.

Table 2: Change of Internal Setup to External Setup

No	Activity	Type	Description
1	Lowering upper dies	Internal	
2	Removing the bolt	Internal	
3	Raising the upper engine base	Internal	
4	Cleaning the press machine area	Internal	
5	Waiting for the forklift	Internal	
6	Lifting dies	Internal	
7	Block the dies	Internal	
8	Moving the dies to the dies storage	Internal	Can be done by operator 2
9	Taking new dies for the stamping washer 1 process using a crane	Internal	Can be done by non-production operators
10	Lifting the dies to the press machine by using a forklift	Internal	
11	Set the top base height	Internal	
12	Fixing bolts for fastening the dies on the machine	Internal	
13	Make sure the dies are set properly	Internal	
14	Taking material for stamping washer components 1	Internal	Can be done by non-production operators
15	Installing the material from the washer 1 component to the coil feeder machine	Internal	Can be done by non-production operators
16	Attaching the material to the coil feeder machine to the press	Internal	
17	Place the reservoir for the remaining pieces of production material (scrap)	Internal	Can be done by operator 2, while operator 1 does production trial
18	Putting the base and the power button	Internal	
19	Conduct trial production and check the quality of washer components 1	Internal	

Table 3: Analysis of the factors that cause high machine downtime and internal setup time

No	What	Where	When	Why	Who	How
1	The length of the process of letting go bolt	Press Machine	The year 2021	Bolts are still used conventional	Operator	Replace it with a clamp bolt (no use thread)
2	There is a process of cleaning the press machine area	Press Machine	The year 2021	The existence of work equipment and goods that are not needed	Operator	Workplace settings with 5S
3	There is an activity waiting for a forklift	Press Machine	The year 2021	Dies to be transferred using forklift	*Forklift Driver*	Replacing forklifts with cranes
4	The dies removal process takes quite a long time starting from lifting, propping, lifting the dies,	Press Machine	The year 2021	The process of removing the dies is assisted by a forklift and shifting it to the center of the machine using a crowbar	Operator and F*orklift Driver*	Design and build work tools in the process of moving dies

Figure 3: Hanging Roller Fixing

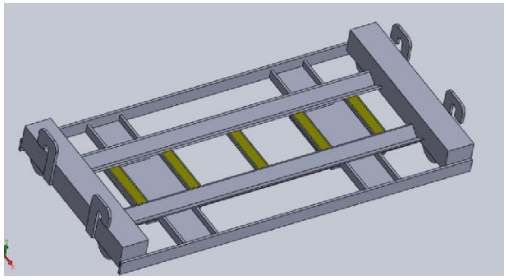

Figure 4: Roller Dies Design

Figure 5: Roller Dies Fixing

Figure 3 is a picture of a hanging roller workpiece. This tool is used as a place to walk the wheels or function like train tracks. The existence of a roller will make it easier for the wheel when pushed.

Figure 4 is a design drawing of the roller dies tool. This tool is made of iron with wheels.

4.6 SMED Implementation

Based on the results of measuring the time of moving the dies with the tools of hanging rollers and roller dies, the time needed to move the dies can be seen in Table 4.

4.6.1 Measurement of Dies Displacement Time. Based on the results of measuring the time of moving the dies with the tools of hanging rollers and roller dies, the time needed to move the dies can be seen in Table 4

Table 4: Process Time for Old Dies Transfer

No	Activity	Type	Time (s)
1	Setting chains and chain hangers	Internal	47
2	Lifting the dies pair and placing them on the dies roller	Internal	32
3	Putting the dies on the dies roller which is above the hanging roller	Internal	13
4	Unleash the chain	Internal	12
5	Pushing the dies into the press	Internal	17

Table 5: Process Time for Old Dies Transfer

No	Internal Activity	Type	Time (s)
1	Setting chains and chain hangers	Internal	47
2	Lifting the dies pair and placing them on the dies roller	Internal	32
3	Pulling the dies onto the hanging roller	Internal	18
4	Setting chains and chain hangers	Internal	47
5	Picking up a couple of dies	Internal	32
6	Putting the dies on top of the storage		15
7	Unleash the chain		12

The total time to transfer the dies to the press is 121 seconds. In the same way, the process of moving old dies can be done, which can be seen in Table 5.

Based on the calculation results, the total time for the setup dies on the SEYI SN2-300 Press Machine is 1945 seconds or 32.42 minutes or a difference of 2144 seconds – 1813 seconds to 331 seconds or 5.52 minutes.

5 CONCLUSION AND FURTHER RESEARCH

Based on the analysis of the results of this study, the following conclusions can be drawn:

1. Dies setup activity on the SEYI SN2-300 Press Machine based on observations, all enter into the internal setup activity where in this condition the machine is in a state of being unable to produce/stop, resulting in a down time of 2144 seconds.
2. Changes from internal setup to external setup have been made for activities to move the dies to the dies storage area, take new dies for the stamping washer 1 process using a crane, pick up material for stamping washer 1 component, install material from washer 1 component to the coil machine

feeder, and placing scrap storage tanks for the rest of the production material (scrap) where this activity can be carried out by non-production operators so as not to interfere with the work of production operators.

3. Changes from internal setup to external setup can reduce downtime by 369 seconds.
4. The factors causing the high machine setup time are due to the long process of removing the bolts, the process of cleaning the press machine area, the activity of waiting for the forklift, and the process of moving the dies takes a long time starting from lifting, blocking, lifting the dies.
5. The design of the tools in the form of hanging rollers and roller die is expected to reduce the machine's internal setup time, where these tools can assist operators in moving old dies and installing new dies into the press machine.
6. Based on the measurement of the setup time after the implementation of the tools made, the results showed that there was a decrease in setup time of 331 seconds or 5.52 minutes.

Suggestions that can be given in this research are:

1. Based on the trial process carried out on the implementation of the use of hanging rollers and roller dies, several problems occur, namely the hanging roller swings while pushing the dies, and the roller dies have not moved smoothly from the hanging roller to the bolster, and the hook chain does not exist, for that stage, the next trial and improvement are still being done to strengthen the setup process with the help of these work tools.
2. From the last conclusion shows that the decrease in setup time is only 5.52 minutes, this happens that the longest internal setup activity is in removing the bolts on the old dies and tightening the bolts on the new dies. can reduce the processing time.
3. Suggestions for further research is to make a useful tool to speed up the process of installing bolts

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