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Lean Manufacturing Approach for Productivity Improvement using SMED (Single Minute Exchange of Dies)

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***Abstract*: As a new company, PT. Tokai Rika Indonesia currently has a problem with setup time process in transition model. The TST-01 line still exceeding the company's target of 4.0% (19.2 minute/shift), but the actual is 12.3% (59.2 minutes / shift) so that the output of production line is not optimal. To improve the transition model more efficient, can used lean manufacturing approach with implement Kaizen and SMED (Single Minute Exchange of Dies) method that can analyze the waste in the TST-01 line and create setup time in transition model more efficient. The data processing is done by identifying problem of setup time in transition model, before the improvement 12.3% (59.2 minutes / shift) and after the improvement up to 3.8% (18.4 minutes / shift). So that there is reduce time of 68.9% (40.8 minutes / shift). The productivity (pcs / hour) before the improvement 37 pcs / hour and after the improvement up to 43 pcs / hour, more than the company's target of 42 pcs / hour, increase 6 pcs / hour.**

***Keywords*: Lean Manufacturing, Productivity, SMED, Waste, Efficiency**

1. Introduction

In the industrial world, competition today is far more dynamic and rapidly changing. Therefore, it is necessary to improve the efficiency and effectiveness of the operation performance [1]. One of the common problems in manufacturing industry is how to carry out the production process as effectively and efficiently as possible without wasting time and production cost so that the company will be able to sell its product in a more competitive price.

Every company have a goal to earn maximum profit. Accordingly, the company must arrange its goal very well with guidance from management function consists of planning, organizing, mobilizing and controlling. In carrying out its activities, the company needs to compile a series of activities that all series of activities must be completed in accordance with the deadline of completion time [2].

The completion time that takes longer than the deadline will disrupt the company's operation. In order to finish work on time, it is necessary to determine the sequence of activities and completion time of each activity. A late completion time will affect increase of the time and cost.

PT. Tokai Rika Indonesia (TRI) is a company engaged in manufacturing that produces automotive interior spare parts for four wheels. The production system used is the pull system (Kanban). At present, PT. TRI still has a problem in the process of setting up the transition model in the TST-01 line that produces steering switches for the 660A (Innova) and 650A (Fortuner) models on the production floor. The allowance time given by the company for setup time is 4% (19.2 minutes / shift) of the working time provided (480 minutes / shift), but the actual time used to setup time exceeds the company's target, which is 12.3% (59.2 minutes / shift). The figure below shows the data for the last six months of setup time from September 2017 until February 2018.

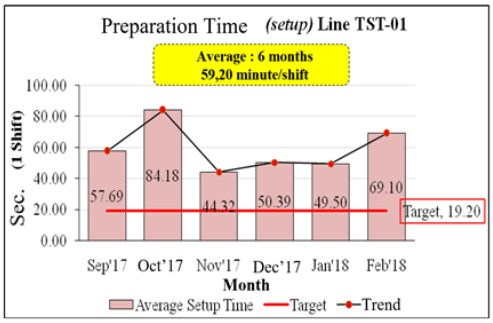


Fig. 1. Setup Time of TST-01 Line

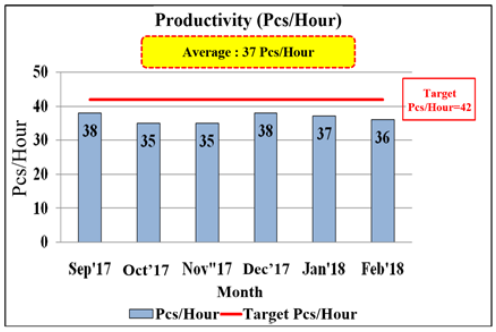


Fig. 2. Productivity of TST-01 Line

As a result of incompletion of the setup time, productivity is

incompleted. The graphic below shows the TST-01-line productivity achievement data (pcs / hour).

To solve the problem, one of the method from lean manufacturing techniques that can be used to optimize the setup time in transition model is SMED (Single Minute Exchange of Dies) method.

2. Literature Review

Lean manufacturing (LM) practices are embedded in five core principles [2]:

1. Determining the value of each specific product in the eyes of the end client;
2. Identifying the value flow of each product;
3. Making the value flow continuously;
4. Letting the customer pull value from the manufacturer and
5. Seeking perfection

Assessing the overall performance of lean through lean practices is typically done using a lean assessment tool (LAT). Various models have been applied as the basic structure of many LATs [2], Waste or Muda is a traditional Japanese term for an activity that is wasteful and doesn't add value. Waste reduction is an effective way for companies to increase profits. Taiichi Ohno, Toyota's Chief Engineer, who is one of the pioneers of the Toyota Production System (TPS) divided the waste that contained in the production floor into "Eight Waste" [3]. Lean is to create a smooth flow of products throughout the value stream process and eliminate all waste. Lean can be defined as a systemic approach and systematic to identify and eliminate waste or activities that are not value-added through continuous improvement by flowing the product (material, work in process, output) and information using pull system of internal and external customers to pursue of excellence and perfection.

Waste is any action or step in a process that does not add value to the business or manufacturing process [4]. Waste is classified into eight types:

1. Over production
2. Excess waiting time
3. Unnecessary transportation
4. Excess processing or processed incorrectly
5. Excess supply
6. Unnecessary motion
7. Defect products
8. Not utilized talent

Single Minute Exchange of Dies (SMED) is one method for reducing set-up time [5]. This concept emerged in the 1960s by Shinggo as one of the founders of the Toyota Production System and this concept was introduced in another country since 1974 in West Germany and Switzerland and 1976 in Europe and America.

Setup time can be defined as the amount of time taken to change a machine from the last part of a production lot to the first good part of the next production lot. So in the setup time there are organizational time such as stopping the engine and calling maintenance, preparing setup equipment, setup time, changeover, the startup itself, making adjustments, and trial run to produce the first good product [6].

Whereas setup time is the time needed to carry out operating / work preparation. The time spent concerns the time of engine component settings, the time of providing work equipment, and so on. Most of the setup is done when the engine stops or the engine is not operating [7].

Changeover time is the time taken to modify the production line for different products or new batches of the same product. Changeover time takes a long time and resulting in production running with a large lot size for one model to avoid repeated changes [8]. This method classify each setup time as internal setup and external setup Internal setup activities are those that require the process to be at a standstill before you can conduct them safely while external activities can be done while the process is still running [9].

One of the Lean methods that can improve the workplace is the Single Minute Exchange of Dies (SMED), which is a methodology that is specialized in reducing setup time. The ultimate goal of SMED is zero setup. Benefits of SMED include reducing inventory, improving flexibility, increasing capacity, and providing better service to customers [10].

SMED methodology consists of the following steps [11]:

1. Step 1: Identification internal and external preparation
2. Step 2: Improve the operation
3. Step 3: Improve tools
4. Step 4: Zero prepare

SMED method will have the following benefits [11]:

1. Reduce set-up time (from a few days can be a few minutes).
2. Shorten manufacturing lead time
3. Reduce bottleneck (WIP drops by 90%).
4. Reduce production cost
5. Improve the quality of the products that is produced

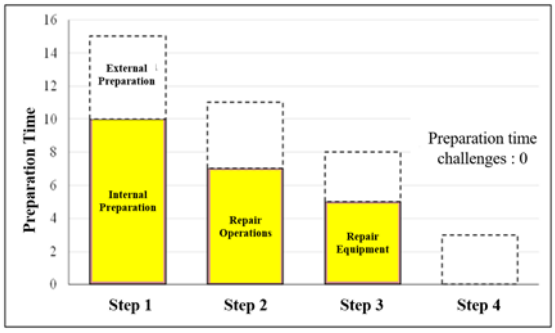


Fig. 3. Steps for improve setup time

A fundamental aspect of the SMED methodology relates to its features of internal and external activities. All setup activities which do not interfere directly with the equipment, and which can be carried out without interrupting production, are designated as external activities.

The actions which imply a stoppage in the equipment running are described as internal activities. The correct separation of the two is what fundamentally contributes to a reduction in setup times [12].

3. Processing and Result

Research methodology is a way of thinking that starts from determining a problem, collecting data through guidebooks or field studies, conducting research based on existing data until drawing conclusions based on the problem that is examined.

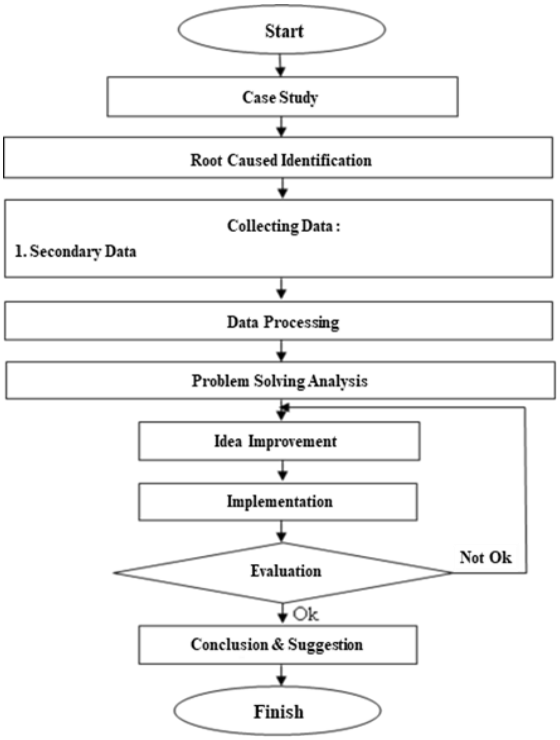


Fig. 4. Research Methodology

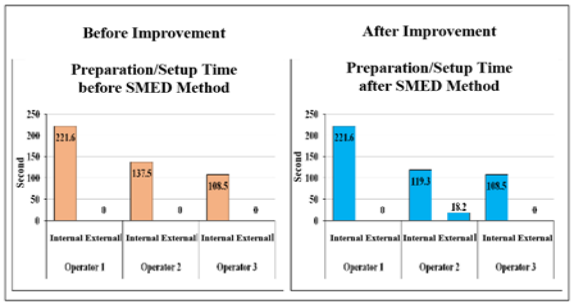


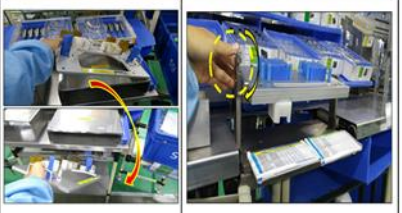
Fig. 5. Result of changing internal setup to external setup

Table 1
Setup Time Data of TST-01 Line

Activity	Operator 1		Operator 2		Operator 3	
	Second	%	Second	%	Second	%
VA	134,0	60,4	69,0	57,8	59,2	54,6
NVA	87,7	39,6	50,4	42,2	49,3	45,4
Total	221,6	100,0	119,3	100,0	108,5	100,0

Source: Data Processing

Table 2
Implementation of Improvement with 5W1H

Type	5W1H	Description and Action
Objectives	What	Improving model change setup and preparation time
Reason	Why	For more efficient preparation and replacement of models
Man	Who	Mr. Agus and Mr. Hadian
Place	Where	Assembly line 1 : Line TST-01
Time	When	Time of improvement : 20 March 2018
Method	How	Improvement Step, will do : Before Improvement / After Improvement  Assembly operator 1, must bring down and pick up new material. And the process of setting up Mold replacement Assembly operator 1 only bring up the tray up or bring down the tray during the process of preparing the mold replacement Improvement Step, will do : Before Improvement / After Improvement  The time of the preparation process and replace the jig is done by exchanging the jigs under the table so that it is not efficient The process of preparing a jig change is done by turning the jig so that it is more efficient

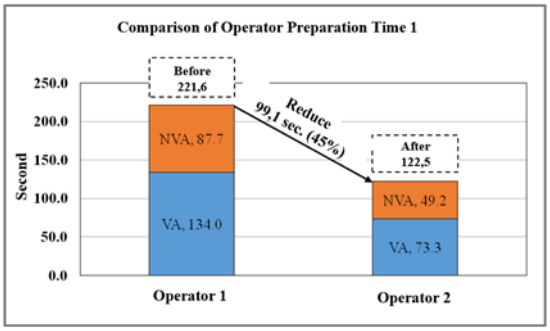


Fig. 6. Chart of Setup Time Operator 1 After Improvement

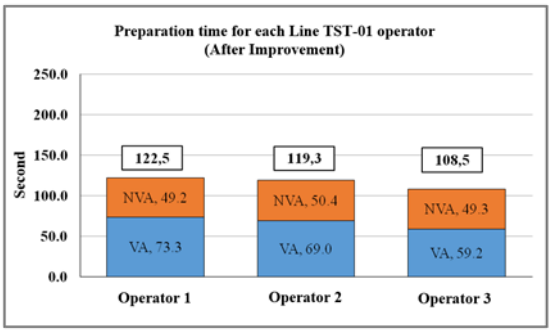


Fig. 7. Chart of Setup Time TST-01 Line After Improvement

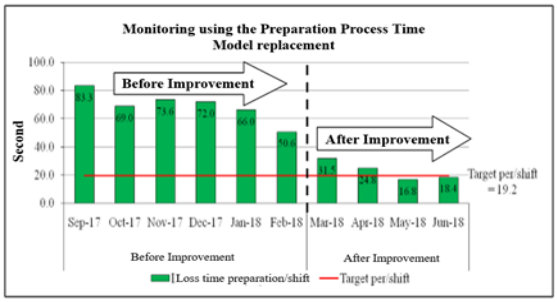


Fig. 8. Chart of Setup Time Monitoring Before and After Improvement

After improvement with the SMED method, resulting in decrease the usage of setup time in one shift. Before improvement, the average of 59.20 minutes / shift and after that become 18.4 minutes / shift, reduced 40.8 minutes / shift. It has reached the company's target, 19.20 minutes / shift.

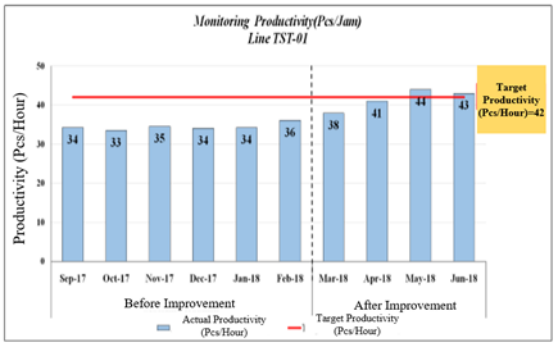


Fig. 9. Chart of productivity monitoring before and after improvement

As in the figure 9, the productivity or output of TST-01 line has increased. The average output before improvement of 37 pcs / hour and after improvement to 43 pcs / hour, the output increases 6 pcs / hour.

4. Conclusion

The conclusions that can be obtained from the research at PT. TRI for the setup time in transition model are as follows:

1. The process for preparing the transition model has reached the company's target of 3.8% (18.4 minutes / shift) from the target company of 4% (19.2 minutes / shift).
2. The productivity (pcs / hour) has increased from before improvement 37 pcs / hour and after improvement to 43 pcs / hour it exceeds the company's target ofm 42 pcs / hour, up 6 pcs / hour.
3. Before improvement, the TST-01 line has a stock on the PC store and after improvement the stock on the PC store is removed.

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