

Implementation of Lean Manufacturing to Reduce Waste in the Maintenance Section in National Automotive Sub Companies of Indonesia

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ABSTRACT

Diamond Motorindo is a company that produces four-wheeled vehicles, one of which is a Multi-Purpose Vehicle (MPV) type. In the MPV manufacturing process, the quality problem that is currently a trend is the AC Not Fill defect. Based on company data for the period March 2019 ~ February 2020, the defect continues to increase. The defect occurred due to the failure of filling the AC gas into the vehicle by the AC Filling Machine. This study aims to determine the OEE value of the AC filling machine is, the factors that cause machine failure that causes defects and can obtain improvement efforts to improve quality. The steps taken in this study are first to calculate the respective values of availability, performance, and rate of quality from the AC Filling Machine to find which variable has the lowest value with the OEE method. After obtaining the variable with the lowest value, the next step is to solve the problem of low variables by using the DMAIC method. After analyzing it, it can be concluded that the average OEE AC Filling Machine value during March 2019 ~ February 2020 is around 96%. This value is still below the target set by the company, which is 98%. What prevents the OEE value target from being achieved is the machine's low rate of quality. The contributing factors are humans, methods, machines/tools, and materials.

Keywords: Waste, Rate of Quality, Overall Equipment Effectiveness (OEE), DMAIC

1. INTRODUCTION

Competition in the business world will never disappear, even growing; this requires companies to keep moving with the times. Companies must continuously improve their competitiveness to survive in running their business, besides that, to grow and develop, to be able to achieve success. For companies, currently success is not only for the internal benefit of the company itself, but also for the benefit of the community and even the economy of a country through the absorption of labor, state revenue through taxes, and finished goods or goods that all levels of society can directly enjoy. According to the BKPM (Investment Coordinating Board) data, throughout 2018 Japan has invested in Indonesia amounting to 4.9 billion US dollars or 16.7 percent of the total PMA. This makes Japan the second largest investment country in Indonesia after Singapore.

PT. Diamond Motorindo is a company that produces four-wheeled vehicles. Not only to meet the domestic market, PT. Diamond Motorindo also has to export its cars to various countries such as Thailand, Vietnam, Philippines, Egypt, Peru, Bolivia, etc. This demand requires PT. Diamond Motorindo continues to strive to provide the best in producing quality products and on-time delivery.

With so many shipping destinations, vehicle specifications for each country are also different because each country has its own regulations regarding motorized vehicles. Therefore, it means that PT. Like it or not, Diamond Motorindo has to increase the usability of its existing machines so that the vehicle production process can run effectively.

Diamond Motorindo is under the auspices of MMC, automatically entered into the Plant Ranking assessment; this is because MMC, the parent company of PT. Besides that, PT. Diamond Motorindo decided to join an alliance with NM and Rnlt. By joining MMC into the alliance, it is hoped that MMC can compete more globally in the automotive industry.

Within the alliance, there are various activities, one of which is the Plant Ranking. In Plant Ranking, all companies under the auspices of each parent company are given a score or score in the areas of safety, quality, delivery, cost, etc. Plant Ranking can also be used as a reference to determine which factories are roughly competent or have the excellent ability to produce a vehicle when there is a New Car Project. Because in the alliance it is possible to do this, for example the PT. Diamond Motorindo is produced in factories owned by NM or Rnlt factories, on the other hand, NM and Rnlt cars are produced in factories under the auspices of MMC.

In order to compete in alliances and also with other competitors, PT. Diamond Motorindo continues to make improvements and also works very seriously to maintain the quality of its vehicle products, one of which is the MPV (Multi Purpose Vehicle) type vehicle.

This MPV, which has a unique Dynamic Shield design, immediately earned a special place in the hearts of the Indonesian people after its launch in July 2017 and has become the main support for the company's profitability, so that PT. Diamond Motorindo must make every effort to continue to make MPV the first choice of customers by maintaining and improving its quality and on-time delivery.

In the MPV manufacturing process it is not without difficulties, the main difficulty faced is quality problems. Quality is indeed a fixed price that every company must be able to meet, including PT. Diamond Motorindo. Quality problems are often the cause of delays in shipments of PT. Diamond Motorindo, this is because the repair process takes a long time.

The quality problem which is currently a trend in the manufacture of MPVs at PT. Diamond Motorindo is an AC Not Fill defect problem. Defect AC Not Fill is a quality problem related to the malfunction of the Air Conditioner of a vehicle, which is usually caused by the failure of the AC Filling Machine when injecting AC gas into the vehicle so that the gas cannot be filled. At PT. Diamond Motorindo, AC filling can only be done with an AC Filling Machine in the production line. If there is a failure in charging the AC, it is certain that the AC Not Fill defect will occur. If so, the car will be in a force pass, aka allowed to pass over the production conveyor without the AC filling process. Cars with the AC condition not filled will enter the Rework Area for pending. Then for the repair process, the cars will be brought back to the line side to be refilled with the AC filling machine at certain times when the line is not doing the production process or when the line is in a stop condition, such as during breaks or on holidays . That is what causes the car delivery process to be late from the predetermined schedule.

AC Filling Machine performance is very decisive in the smooth delivery of vehicles at PT. Diamond Motorindo. If there is a problem with the machine, it will automatically impact the delivery process. Delivery delays caused by failed AC filling in the AC Filling Machine have happened very often. The Defect AC Not Filling graph can be seen in Figure 1



Figure 1 Defect AC Not Filling Graph

Similar research has also been carried out by (Rimawan et al., 2018). The three of them researched "Measurement value analysis of overall equipment effectiveness (OEE) packaging process in line 2 (Case Study of PT. MBI Tbk)". In this study, it is known that the availability value only reaches 88.85%, and the performance value is only 78.51%; these numbers are still below the world standard, namely 90% and 95%, respectively. Losses of around 19.12% were caused by weak supervision systems so that workers or operators did not work following what had been set.

(Hervian & Soekardi, 2016) conducted research on "Improving Productivity Based on Evaluation Score of Overall Equipment Effectiveness (OEE) Using DMAIC Approach on Blistering Machine." In his study, TPM combined with the DMAIC method was used to find out and analyze problems taking corrective action on a blister machine. In making repairs, SMED is also used to speed up the path cleaning process. The results showed that the OEE score increased from 49.05% to 64.05%. It represents a practical improvement, and if done consistently, it will produce beneficial results.

(Nurpentangin et al., 2017) conducted a study on "Proposed Glue Toelasting Machine Performance Improvements with the Integration of the OEE Method and the DMAIC Method (Case Study of a Shoe Manufacturing Company)." In his research, the calculated OEE was 72% with each component, namely, the availability factor of 95.5%, the performance factor of 90.8%, and the quality factor of 82.5%. Thus, the problem area that is the top priority to be resolved with DMAIC is the quality factor of the glue toelasting machine. With the background of the above problems, the writer wants to research to calculate the OEE from the AC Filling Machine, find the root cause of the problem, and suggest improvement to PT. Diamond Motorindo.

2. LITERATURE SURVEY

2.1 Production and Production Systems

According to Haizer and Rander (2010), production is the process of creating goods and services. The goods and services that are produced are to fulfill human needs. In general, production is defined as an activity or process that transforms inputs into outputs. Production activities require production factors such as natural resources, labor, capital, and technology. In essence, production is the creation or addition of benefits or form, time and place to the factors of production so that they are more beneficial to human needs. The production system is a series of interconnected elements and mutually supporting one another to achieve a certain goal (Nasution & Prasetyawan, 2008; Prasetyawan, 2015).

2.2 AC Filling Machine

AC Filling Machine is a device used to fill refrigerant or better known as Freon into a vehicle. AC Filling Machine has the following functions:

1. FLUSHING

- a. Drains AC compressor oil with high accuracy (100%) accurately, without removing a single bolt, computerized.
- b. Clean the inside network in the AC system configuration.
- c. Detecting car air conditioning problems with a computerized system.

1. RECYCLE

The cleaning process that continuously rotates the components of the AC system that can guarantee rinsing and recovery so that a computerized level of improvement in cleanliness is obtained.

2. RECOVERY

Drains the refrigerant completely from the car air conditioning system and is directly accommodated in the cylinder on the lax engine, so it doesn't damage the environment.

3. VACCUM

The suction of blockages in the AC system is done by a double pump process so that it is able to suck air up to 100 mm Torr.

4. CHARGING

Charging using a computerized system, because it is essential to get accurate results in setting refrigerant and oil back into the car AC system according to the specifications and recommendations of the car manufacturer.

2.3 TPM (Total Productive Maintenance)

TPM is a maintenance program that involves a conceptual description of equipment and plant maintenance with the aim of increasing productivity and at the same time improving job satisfaction and employee morale. Total productive Maintenance (TPM) is a program concept concerning maintenance that involves all workers through small group activities (Nakajima, 1988; Tsao et al., 2020; Pauli, 2020).

Total Productive Maintenance includes several things such as total commitment to the program by top management, granting broader authority to workers to take corrective actions, and is an activity that takes a relatively long time to implement and the process takes place continuously. TPM makes maintenance activities an essential focus in business and is considered an unprofitable activity. In TPM, downtime for maintenance is scheduled as part of the daily production process and is an integral part of the production process.

2.4 Overall Equipment Effectiveness (OEE)

Overall Equipment Effectiveness (OEE) is a method used as a measuring tool (metric) in implementing the TPM program to keep equipment in ideal condition by eliminating Six Big Losses of equipment. In addition, to measure the performance of a productive system. Identifying the root of the problem and the factors causing it to focus on making improvement efforts is the main factor in this method being applied comprehensively by many companies in the world.

2.5 DMAIC method

Define, Measure, Analyze, Improve, and Control (DMAIC) is an essential component of the six sigma methodology used to improve the performance of a process by eliminating defects.

3. RESEARCH METHODOLOGY

The research methodology must be determined in advance so that research can be carried out in a directed manner and facilitate the analysis of the problems to be carried out. The research methodology in this study consists of several stages, including initial observation, literature study, preliminary, theoretical basis, data collection and processing, analysis, and conclusions and suggestions.

3.1 Types of Research

This study, using a quantitative research type because its implementation includes data in the form of numbers or numerals. Following its form, quantitative data can be processed or analyzed using mathematical calculation techniques.

3.2 Types of Data and Information

The types of data used in this study consist of 2 types, including:

Quantitative Data

According to (Sugiyono 2004), quantitative data is data in the form of numbers or qualitative numbers recorded (scoring). Quantitative data in this study, namely data obtained from the company in numbers such as data on material purchases, data on material usage, data on storage costs & message costs, material price data, quantity data on hand, and lead time.

Qualitative Data

According to (Sugiyono 2004), qualitative data is data in words, sentences, schemes, and pictures. Qualitative data in this study is data obtained from companies in the form of information both oral and written, namely information about the description of all non-value-added activities.

Data source

This study uses 2 data sources, namely:

1. Primary Data

Is data obtained directly from the object of research through direct observation or interviews Primary data include images and information from interviews with employees.

2. Secondary Data

Is data that comes from data or documents owned by the company. This secondary data includes production data from March 2020 to February 2020.

3.3 Data Collection Methods

The methods used to obtain data in the writing of this thesis are:

1. Field research

Field research is a form of research carried out by means of observation, interviews, to obtain data that is more precise and reliable according to the needs needed to support the writing of this thesis. The data is in the form of primary data and secondary data.

a. Primary data, namely data obtained directly in the field. In this study, the data was obtained by interview method with the head of the production department.

b. Secondary data, namely previously processed data, the authors only quote from existing data based on company documentation.

2. Literature Research

Literature research is a literature study closely related to the issues to be discussed, including TPM, OEE, and DMAIC.

3.4 Data Processing and Analysis Methods

The data that has been taken is processed by calculating the OEE method, namely calculating the value of machine availability, machine performance, and machine quality ratio and then looking for the machine's OEE value.

4. RESULT & DISCUSSION

The results of the improvement efforts that have been carried out are monitored for 2 months, from March 2020 to April 2020 to determine the value of the quality of the machine rate and the achievement of the OEE AC Filling Machine. The results can be seen in Table 4.1

Table 4.1 Achievements of OEE AC Filling Machine March 2019 - April 2020

Bulan	Availability	Performance	Rate Of Quality	OEE
Mar-19	99,71%	100%	97,77%	97,48%
Apr-19	99,71%	100%	97,57%	97,29%
Mei-19	99,72%	100%	97,49%	97,21%
Jun-19	99,65%	100%	97,23%	96,89%
Jul-19	99,75%	100%	97,19%	96,95%
Agu-19	99,75%	100%	96,85%	96,61%
Sep-19	99,72%	100%	96,85%	96,57%
Okt-19	99,73%	100%	96,79%	96,53%
Nov-19	99,70%	100%	96,33%	96,04%
Des-19	99,56%	100%	95,99%	95,57%

From Table 4.1 above, it can be seen that the rate of quality in March 2020 and April 2020 increased to 99.51% and 99.54%. This also made the OEE value increase, namely 99.27% in March 2020 and 98.93% in April 2020.

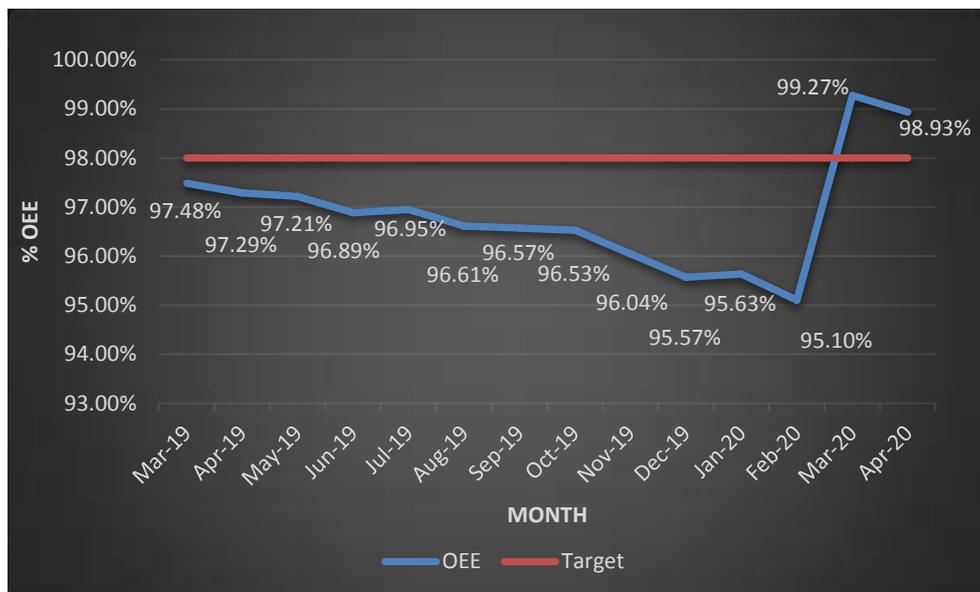


Figure 4.2 Achievements of OEE AC Filling Machine March 2019 - April 2020

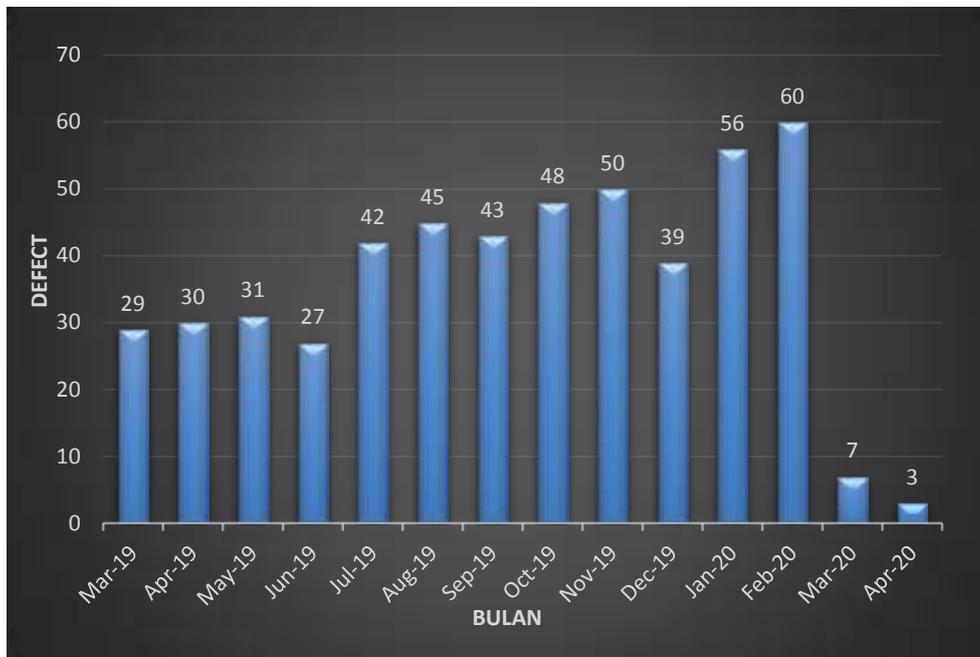


Figure 4.3 Defect AC Not Filling March 2019 - April 2020

With the increase in the value of the OEE AC Filling Machine, the number of defects generated from the machine will automatically decrease. From Figure 4.2 above, it can be seen that the defect has dropped drastically. In March 2020 the number of defects found dropped to 7 cases followed by 3 cases in April 2020. This indicates that the repair efforts carried out were quite successful, but it still needs to identify deeper problems to completely eliminate the defect.

5. CONCLUSION

5.1 Conclusion

Based on the descriptions, discussion, and analysis that the author has done in previous chapters, it can be concluded as follows:

1. Based on the results of the Overall Equipment Effectiveness (OEE) calculation on the AC Filling Machine at the MPV production line of PT. During March 2019 ~ February 2020, Diamond Motorindo obtained an average Overall Equipment Effectiveness (OEE) value of around 96%, and that number continues to decline. The OEE value has not been able to meet the target set by the company, which is 98%.

2. The main factors that cause the low value of the rate of quality are:

a. Factor Man

Lack of training on signs of machine abnormality so that the operator does not know that the gun seal has been damaged.

b. Machine / Tool Factor

The condition of the engine seal parts has entered the replacement age (the first replacement since the purchase of a new machine).

c. Method Factor

Not listing the correct gun handling method in the SOP, causing the machine operator to do bad handling, namely when placing the gun on the gun holder hard to collide with the holder, then damages the inner seal.

d. Material Factor

The quality of the part material is low so that it makes the parts more easily damaged. Back.

3. Improvements made to improve the OEE AC Filling Machine include:

- a. Providing training to operators regarding machine abnormalities, especially AC Filling Machines and training on Stop, Call, Wait so that any potential damage can be overcome from the start to not cause significant damage, which is much more detrimental.
- b. In the future, the maintenance department must schedule replacing parts that are easily damaged, such as seals, couplers, o-rings, etc., to avoid a decrease in quality or even machine availability.
- c. Making a new gun holder to protect the gun from collisions that can cause damage.
- d. Using high-quality parts to maintain machine durability and to produce good products.

5.2 Suggestions

Based on the above conclusions, there are several suggestions that the authors expect for PT. Diamond Motorindo, namely:

1. Companies can make quality improvements by focusing repairs on types of damage that are very large in total or dominant in production.
2. In general, the main causes of damage come from man and machine factors; this is based on research conducted, where the AC Not Fill defect occurs during the production process. Therefore, efforts to make improvements are by checking the machine's condition, in this case, the Seal Gun, before doing the job.
3. Looking back at all machine work instructions, are there things the same as in the cases discussed, namely the absence of standards regarding equipment handling, etc.
4. Looking for references to suppliers of high-quality machine parts so that the machine damage factor caused by low-quality parts can be eliminated.

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