Analysis of Production Obstacles in Assembling G Line Process Using FMEA Method (Failure Mode and Effect Analysis)

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Abstract. PT. XYZ is a company engaged in the manufacturing industry of manufacturing four-wheeled vehicles. Based on the results of preliminary observations, it was found that the production process in the G Line assembling section in this company had problems that could hamper the smooth production process. Problems that occur during the production process can reduce work time so that the number of products produced by the company becomes reduced. These problems can also result in the number of products produced not according to the number of products planned. To reduce the barriers to production, this study uses the FMEA method to identify the most potential causes of production barriers in the G line assembling process and recommendations for the solutions given. Based on the research conducted, it is known that there are several types of production barriers. Then the calculation of the percentage of disability is done to obtain a pareto diagram. Based on the calculation results, it was found that the types of production barriers analyzed were final line no body with a total resistance of 1400 and a percentage of disability 75.31%. The recommended solution is to provide training to operators so that operators have better skills.

Keywords: Production Barriers, FMEA, Pareto Diagram, Cause and Effect Diagram

1. Introduction

Plant II is a new project specifically for four-wheeled vehicles. Here do pressing, welding, painting, and assembling (assembling) four-wheeled vehicles, using a variety of high-tech equipment and is the largest in Southeast Asia for now.

The assembling process is the process of combining body units that have been maintained with the engine and other components, such as wheels, seats, dashboards, interiors, and other components into one unit of the car. This process includes the trimming process, chassis, and final. Chasis is the process of assembling car parts related to the chassis. Trimming is the process of assembling the top of the car or the installation of the interior and exterior of the car. Final is an assembling process for completeness after the trimming process and chassis such as wheels, fuel, bumpers, and other fittings.

The assembling process at PT. XYZ has problems in the process. Problems that occur during the production process can reduce work time so that the number of products produced by the company becomes reduced. These problems can also make the number of products produced not in accordance
with the number of products planned. Based on this, the researcher wants to identify the types and causal factors in the problem of assembling using FMEA so that it can provide recommendations for solutions that must be corrected by the company.

Failure modes and effects analysis (FMEA) first up from studies done by NASA in 1963 and spread to the car manufacturing industry to identify potential defect at the stage of product design [1]. FMEA is a methodical approach to identifying the possibility of failure modes of a manufacturing process or a product to provide key information for improvement and risk assessment [2][3]. Failure modes are the ways, or modes, in which an product can fail/defect. The purpose of FMEA is to identify the possibility of problems in the early design process of a system or product that can influence its safety and performance, and to introduce a treatment to minimize the effects of the identified potential problems (failure modes) [4].

Many previous studies have been carried out to identify type and causal factors using FMEA such as in Steel Industrie Factory [5], in asset maintenance [6], in the supply chain risk environment [7], for healthcare risk analysis [8], and the others’s study. The purpose of this study to identify the types and causal factors in the problem of assembling.

2. Method
The method used in this study is in the form of direct observation in the field of the G Line assembling process, accompanied by interviews with the head of production. The secondary data collected in the form of general data about the company and historical data on production barriers at PT. XYZ. The steps taken in carrying out this research are as follows:

1. Field Study
   Field studies are conducted to obtain information about the general description and actual conditions of the company

2. Library Studies
   Literature studies are conducted to obtain and better understand theories related to problem solving. The source of the literature comes from books, journals, and studies of previous research on the main topics.

3. Problem Formulation
   Based on literature studies and field studies, existing problems will be known so that the problems being studied can be formulated

4. Determination of Research Objectives
   Determination of research objectives is used to explain what goals you want to achieve with the holding of research.

5. Data Collection
   Data collected in this study include primary data and secondary data, namely: company overview data, organizational structure data, data on current number of workers, job description data for each worker, production barriers data.

6. Data Processing
   This study identifies the most potential causes of production barriers in the G Line assembling process using FMEA. FMEA is a method to identify and analyze potential failures and consequently aim to plan production processes well and can avoid production process failures and unwanted losses. The purpose of implementing FMEA is to prevent problems occurring in processes and products. The result is a better process because corrective actions have been taken and reduced and eliminated failures [9]. The steps using FMEA is:
   • Calculate the percentage of barriers to production and depiction of pareto diagrams
   • Determine the factors that significantly influence production barriers.
   • Calculate the value of Risk Priority Number (RPN).
   Risk Priority Number (RPN) was calculated by multiplying severity of the error (S), the probability of occurrence (O), and detect ability (D). Errors with RPN >100 were identified as high risk errors. The RPN formula is as follows
   \[ RPN = S \times O \times D \] (1)
Provided a solution recommendation

7. Analysis and Conclusion

The analysis and conclusions carried out in this study, namely analyze the percentage of production barriers and analyze the factors that significantly influence production barriers. After that, create a conclusion which are the final summaries that are able to answer the research formulations carried out and provide research suggestions.

3. Results and Discussion

3.1. Pareto Diagram

Pareto diagrams are made to find or find out the problem or cause that is the key to solving problems and comparison to the whole. By knowing the dominant causes, priority for improvement can be determined. This improvement in the dominant causal factors will have a greater effect than the resolution of the causes that are not meaningful. The results of calculating the percentage of obstacles for other types of obstacles can be seen in Table 1.

| Types of Production Barriers | Total Obstacles | Percentage of Obstacles | Cumulative Percentage |
|-----------------------------|-----------------|-------------------------|----------------------|
| Final line no body          | 1400            | 75.31                   | 75.31                |
| Lifter suspension error     | 214             | 11.51                   | 86.82                |
| PBS error                   | 52              | 2.8                     | 89.62                |
| Pokayoke error              | 38              | 2.04                    | 91.66                |
| DL -1 error                 | 20              | 1.07                    | 92.73                |
| Shipping problem part       | 17              | 0.91                    | 93.64                |
| Repair in line / pull andon | 15              | 0.81                    | 94.45                |

Based on the data in Table 1. above can be made a pareto diagram for production barriers at PT. XYZ as seen in Figure 1.

![Pareto Diagram Industry Barriers](image)

**Figure 1.** Pareto chart of obstacles to production of g line assembly parts.

Pareto used in solving this problem is to use Pareto 70% - 30%. Based on Pareto rules 70% - 30%, problems that have a cumulative percentage of more than or equal to 70% must be analyzed further.
Based on the results obtained, the obstacles to be analyzed further are the final line no body because it has a cumulative percentage of 75.31%.

3.2. Cause and Effect Diagram
This diagram is useful for analyzing and finding factors that have a significant effect in determining the characteristics of the quality of work output. In addition, this diagram is useful for finding the real causes of a problem. From the results of observations made at PT. XYZ, then analyzed and determined the factors that significantly influence the search for the real cause of the final line no body problem. The factors that significantly influence the final line no body problem are shown through the Cause and Effect Diagram in Figure 2.

![Cause and Effect Diagram](image)

**Figure. 2.** Cause and effect diagram final line no body.

Based on the image of Cause and Effect, the diagram above shows that the causes of the final line no body are as follows.

1. Humans
   a. Old operators carry out body painting inspection processes because the components that have to be inspected are many, so it takes a long time to complete the inspection process. The long inspection process causes fewer bodies to enter the G line assembly.
   b. Operators have poor skills so that they work on old body painting. The process of making old body painting can cause the body to enter the G line assembly part to be less.

2. Material
   The resulting body painting is a bit so that it will cause the final line no body.

3. Working method
   Installation of components in the final section is less than the other stations, causing the assembly process in the final section to be completed faster and causing a body vacuum.

4. Machine
   a. The conveyor runs quickly so the final line will quickly experience a body vacuum.
   b. An error occurred on the machine which caused body painting to be blocked from entering the line assembly

3.3. FMEA
FMEA is a method to identify and analyze potential failures and consequently aim to plan production processes well and can avoid production process failures and unwanted losses. Making FMEA begins by determining in advance the effects arising from failure in the process, the causes of failure and
controls carried out to prevent the effects of the failure of the process. Giving scores on each component is done by giving a prior assessment of the severity, occurrence, detection, and the end result in the form of a risk priority number. Calculation of the RPN value and the recommendations for the solutions given to the causes of the occurrence of the final line nobody can be seen in table 2.

**Table 2. Calculation of value of risk priority number (RPN) and recommended solution.**

| Category causes barriers | Severity | Factors affecting | Occurrence | Current Control Process | Detection | RPN | Recommended Solution |
|--------------------------|----------|-------------------|------------|-------------------------|-----------|-----|----------------------|
| Human                    | 7        | Old operators carry out body painting inspection processes | 7          | Supervision is done visually | 4         | 196 | The inspection process is carried out using more sophisticated equipment |
|                          |          | Operators have poor skills | 7          | Supervision is done visually | 7         | 343 | Training is carried out for operators Preventive maintenance on the engine |
| Engine                   | 5        | Machine error | 8          | Engine repairs performed | 6         | 240 | Regulating the conveyor rate |
|                          |          | Conveyors run quickly | 9          | Supervision is done visually | 5         | 225 | The painting process is carried out using better technology |
| Material                 | 5        | The little body painting produced Fewer installation of components in the final section | 9          | Supervision of operator performance | 7         | 315 | Workload balancing is done |
| Working Method           | 7        |                                | 9          | Supervision of operator performance | 4         | 252 | |

Based on the calculation of the RPN above, it was obtained that the main priority of repairs at PT. XYZ is paying more attention to the skills possessed by operators, especially new operators in order to produce good body painting. The recommendation given for this problem is training the operators so that operators have better skills.

4. Conclusions

The conclusions obtained from the discussion above are as follows.
1. Types of production barriers that occur in the assembling process at PT. XYZ is the final line no body, lifter suspension error, pbs for errors, pokayoke error, dl -1 error, problem with part delivery, repair in line / pull andon, problem ordering parts, dl -2 error, slow sub assy process, hoist error, conveyor / hanger, welding problems, rear axle lifter error, power steering filling error machine, sloping body, etc -4 error, and broken knuckle press machine.
2. Based on the obstacles in the points above, the most common type of obstacle is the final line no body, which is as much as 1400 with a percentage of 75.31%.
3. Problems Final line no body is caused by operators having poor skills.
4. Recommendation for a solution to the causes of the obstacle is training the operator so that the operator has better skills.

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