Analysis of Causes of Defects Gloves and Bar Soap Using Failure Mode and Effect Analysis (FMEA) in XYZ Company

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Abstract. XYZ is a company engaged in the production of gloves and soap. The problem faced by XYZ Company is a disability that exceeded the standard limit set by the company. The disability can be derived from various aspects such as raw materials, machinery, people and work methods used. Types of defects that occur are for glove products such as thickness, torn and leaking. While the defects that occur in the soap bars product are dented, broken and cracked. Under these conditions, it is necessary to determine the cause of the disability by using Method Failure Mode and Effect Analysis (FMEA) for analysing each potential failure cause, prevention and detection. The formula used is RPN (Risk Priority Number) which is a scale of Severity x Occurrence x Detection. Results indicate if the product FMEA glove, the highest RPN of 126 is the unsuitable tumble dryer machine setting that causes the type of disability in the thickness of the glove. While on the soap products, the highest RPN of 168 is on the human factor is the lack of skill of workers. Both results of a given proposal are that the company controls the machine process so that the drying standard is achieved and provides training to the workers to improve the skills of workers.

1. Introduction
Defective products are products that do not meet specifications [1]. This means also not in accordance with predetermined quality standards. Defective products that occur during the production process refer to products that are not accepted by consumers. The defective product is a product that does not meet the specified quality standard but with the cost of rework to improve the product economically can be refined again into a better product.

XYZ is a company producing disposable gloves with high quality and a soap bar that has good quality and quantity. The types of gloves produced by XYZ company is smooth (slick) and textured. XYZ Company has a limit of the desired standard defect rate of 5%. As for the level of disability glove obtained from the company amounted to 9-10%, while the company's desired standard limit is 5%. The resulting glove is said to defect if not in accordance with the desired limits corporate standards such as torn, thickness and leaky. Based on the problem it is necessary to do research for defects in the product of gloves and bar soap can be minimized. XYZ company has made some improvements to the work system and machine repairs to reduce the number of product defects, but these improvements have not run optimally and still produce defective products on the production floor. This causes the consumer's view of the company to be less good, the cost of production is increasing, and resulted in corporate profits to be down. If the company can make good quality control improvements on gloves and soap
products, it will reduce the failure rate of the resulting product so that it can meet the consumer's wishes [2].

2. Methods
Study was conducted at XYZ Company, this type of research is descriptive. This is because this study was limited to making the right description, what about the facts and the properties of the object without making predictions or seek solutions to problems that exist in the object. This study uses Failure Mode and Effect Analysis (FMEA) [3].

The object of research is the quality of the gloves and soap bars that does not meet specifications or standards and is classified as a defective product. The initial phase of the research carried out with a preliminary study in the form of direct observation of spaciousness. The process of data collection is done by recording the types and amounts of each disability.

The steps taken for FMEA are: At this stage, the measurement of all processes of production activities. Stages of work done include:

1. Identify functions in the production process.
2. Identify potential failure mode production process
3. Identify potential effects of production failure
4. Identify the causes of failure of the production process.
5. Identify production process detection modes.
6. Determine rating on severity, occurrence, detection and RPN production process.

Measurements of the size of severity, occurrence, and detection in the process of making gloves and soap, are as follows:

1. Severity Value
   Severity is the first step to analyze the risk, is calculate how much impact or intensity of events affect the outcome of the process. The rating impact starts on a scale of 1 to 10, of which 10 is the worst impact and the rating determination can be rewritten.

2. Occurrence Value
   If the rating is determined in the process of severity, then the next step is to determine the rating of the occurrence value. Occurrence is a possibility that the cause of failure will occur and produce a form of failure during the production period of the product. Determination of occurrence value can be rewritten.

3. Detection Value
   After occurrence value is obtained, next is to determine the value of detection. Detection Function for prevention of production prose. Detection of detection value can be rewritten. After obtaining the severity, occurrence, and detection value on the manufacture of soap product, RPN value will be obtained by multiplying the severity, occurrence, and detection values (RPN = S x O x D), then sorting the highest value to the lowest. After that, production process activities that have a large RPN value has an important role in a production activity, made suggestions for improving the level of defect product.

3. Results and discussion
   At this stage, an analysis of the causes of defects in product gloves are thick and torn by using cause and effect diagram. Cause and effect diagram for thickness disability can be seen in Figure 1.
Figure 1. Cause and Effect Diagram of Glove Thickness Disability

Figure 1. indicate three factors that affect disability glove thickness types, they are:
1. Machine, namely the lack of standards in the determination of machine settings tumble dryer, so the drying process is not optimal gloves.
2. The working method, which is standard operating procedure in the glove production process is not executed properly, resulting in the occurrence of errors in producing gloves.
3. Material, which is the raw material used does not match the desired specifications, it is because they contaminated liquid latex impurities such as leaves, twigs and sand.

Cause and effect diagram of torn gloves products disability can be seen in Figure 2.

Figure 2. Cause and Effect Diagram of Torn Gloves Disability

Figure 2. indicate three factors that affect disability torn glove types, they are:
1. Environment, is a dusty working environment will pollute the latex during the production process, this can reduce the elasticity of latex.
2. Machines, namely the temperature generated by the blower machine unstable so that the drying process former is uneven and result in torn gloves.
3. Men, the inaccurate operators and SOP are not executed properly during the process of withdrawal of the glove from the mold.

The results of the analysis on soap bar products, identification of the factors of production that directly affect the bar soap is the type of disability dented. Cause and effect diagram for dented disability can be seen in Figure 3.
Figure 3. Cause and Effect Diagram of Dented Bar Soap Disability

Figure 3 indicate four factors that affect disability dented soap bars types, they are:
1. Working methods, such as the duration of cooling and cooking time in the process that is not optimal so it has a standard so that the process of making soap is not in accordance with company standards.
2. Men, such as less skilled workers, fatigue operators, operator barriers so as to cause production results that do not have standard production standards at each stage.
3. Raw materials, such us the quality of raw materials are not in accordance with the standards, causing defects that exceed the limits of tolerance of the company.
4. Machines and equipment, such us the machine does not produce the appropriate size because of the problem cutting machine and the remaining material in the machine causing the cutting result on bar soap not in accordance with company standard.

3.1. Failure Mode and Effect Analysis (FMEA)

FMEA is a method to identify and analyze potential failures and consequently aimed to plan the production process is steady and can avoid the failure of the process of production and losses desired. After the value severity (s), occurrence (o) and detection (d) obtained, then calculate the value of the RPN to determine priorities in the corrective action recommendations [4].

The calculation of the value of the RPN (Risk Priority Number) on the cause of setting machine tumble dryer for glove is:

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RPN = S \times O \times D
\]

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= 7 \times 2 \times 9
\]

\[
= 126
\]

From the calculations RPN is knowable factors causing the failure of the process that results in defective products gloves products. These factors are then sorted by the highest RPN value that can be seen in Table 1.
Table 1. Sequence of causes of process failure based on RPN gloves

| Type of failure | Due of Failure | Factor | S | Failure Causes | O | Proposed Improvements | D | RPN |
|-----------------|----------------|--------|---|----------------|---|----------------------|---|-----|
| thickness       | Gloves does not match the production standards, the number of products in the recycle and disrupt the function of the product. | Machine | 7 | Setting the tumble dryer does not correspond | 2 | Make a checklist to monitor the setting machine tumble dryer | 9 | 126 |
|                 | Working Methods | 4 | Operators do not run the SOP with either | 3 | Develop working methods more systematic | 8 | 96 |
|                 | Material | 5 | Contains dirt | 3 | Conduct regular inspections of raw materials before the production process | 5 | 75 |
| torn            | gloves do not match production standards; many products are in the recycle and disrupt the function of the product | Environment | 6 | working environment is dusty | 3 | Creating ventilation in the work environment and conduct hygiene routine | 7 | 126 |
|                 | Machinery | 6 | temperature blower unstable | 3 | conduct regular inspections of the resulting temperature blower | 6 | 108 |
|                 | Material | 4 | been less conscientious and SOP does not run well | 3 | options for closer scrutiny and briefed prior to the production process carried out | 7 | 84 |

Based on Table 1, for the thickness problem the highest value of RPN is 126 to the cause of the failure is the setup machine tumble dryer does not correspond, which is a kind of failure that the first priority for immediate repairs.

As for the bar soap products recapitulation FMEA results to the type of disability dented can be seen in Table 2. RPN is Risk Priority Number obtained from the multiplication of the value of Severity (S), Occurrence (O) and Detection (D) contained in the form FMEA.

Table 2. Sequence of causes of process failure based on RPN Bar Soaps

| Type of Failure | Factor | Due of Failure | S | Failure Causes | O | Proposed Improvements | D | RPN |
|-----------------|--------|----------------|---|----------------|---|----------------------|---|-----|
| Dented Man      | Annoying product function and not accepted by consumers | 8 | less skilled | 7 | The company made a training schedule for workers. | 3 | 168 |
|                 | 6 | Operator Fatigue | 5 | Companies specify hours of rest which remained | 3 | 90 |
|                 | 8 | Failure been | 5 | Provide a warning to operators that fail to work | 4 | 160 |
| Raw             | Disruptive product function and not accepted by consumers | 8 | Quality of raw materials is not according to the standard | 5 | Perform inspections of raw materials the supplier is in conformity with the standards set | 4 | 160 |
| Machinery and Equipment | Disruptive product function and not accepted by consumers | 8 | The machine does not produce the appropriate size | 4 | Do the planning of preventive maintenance on the mower | 3 | 96 |
|                 | 6 | There is a residual material in the engine | 5 | Companies cleaning machine and equipment periodically | 3 | 90 |
| Interfering method | Interfering product function and not accepted by consumers | 8 | old cooling | 4 | Setting standards for long cooling | 3 | 96 |
|                 | 7 | old ripening | 4 | Setting standards for long cooking | 2 | 56 |
Table 2. it can be seen that the highest RPN value contained in the human factor to the cause of the less skilled operator.

3.2 Proposed improvements
From the analysis conducted on gloves by using thickness is setting machine tumble dryer is not appropriate for the type of disability tear is dusty work environment. The proposed remedial actions to the type of disability thickness is by examination of Cause and Effect Diagram, can be seen the factors that most affect the quality of the gloves to the type of disability and care on a regular basis, so that the heat produced by the engine tumble remains stable dryer [5]. While the proposed corrective actions to the type of torn disability to make the work environment ventilation and cleanliness routinely do so as a latex are not contaminated with dust during the production process takes place that does not reduce the elasticity of latex [6]. As for the operator skill bar soap products play an important role in the production of soap because soap production process does not have a standardized production standard at every stage. Therefore, repairs can be done in two ways, they are the improvement of the operator and operating standards.

4. Conclusion
Type glove product defects are the most dominant defect types of thickness (37.01%) and the type of disability torn (34.89%). There are several causes of disabilities thickness and tear. As for the type of disability are torn dusty working environment, temperature of machine blower unstable and less scrupulous operators and standard operating procedures are not executed properly. Based on the calculation of RPN, the cause of disability which has the highest RPN 126 value that the setting tumble does not match dryer. To overcome this, the corrective action taken is to make a checklist to monitor machine settings tumble dryer.

Type of disability soap consists of Dented, cracked and broken. The most dominant type of disability in the production of soap bars is Dented disability. Dented dominant source of disability in the production process of soap bars use cause and effect diagram obtained from humans, machines and equipment, raw materials, work environment and work methods. The biggest factor risk of failure in the RPN is 168 from the human factor as the operator skills.

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