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Failure Risk Analysis on Glass Bowl Products Using Failure Mode and Effect Analysis (FMEA) Method at PT. Kedaung Indah Can, Tbk

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Abstract– PT. Kedaung Indah Can, Tbk is a manufacturer and exporter of canned/tin products and enamel steel cookware, one of which is glass bowls. During the production process, problems often arise, namely a fairly high level of product defects. These defects occur more often in the inspection process, namely the process before the product is handed over to consumers, the inspection section will check and test the product according to applicable standards and provisions. In this study, the author aims to identify the risks that occur so that they can produce high productivity and propose improvements in reducing defects. The method used to solve this problem is Failure Mode and Effect Analysis (FMEA) to determine the dominant failures that cause product damage and determine the priority of repairs from the results of the Risk Priority Number (RPN) value. The results of this study indicate that there are 3 types of defects that produce RPN values, including broken glass bowls with an RPN value of 192, cracked glass bowls with an RPN value of 125 and untidy bowl colors with an RPN value of 100.

Keywords: *Defect, Failure Mode and Effect Analysis, Risk Priority Number*

1. INTRODUCTION

Rapid economic development has created increasingly tight business competition in all industrial sectors. Companies are required to continue to innovate and optimize all aspects of their operations in order to achieve competitive advantage and dominate market share by implementing effective and efficient strategies. In the process of achieving competitive advantage, of course there is a potential risk

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of failure. Failures that arise in the company can be identified and prevented with structured procedures using Failure Mode and Effect Analysis (FMEA). FMEA will improve the reliability of a product and service with the aim of increasing consumer satisfaction with the product and service. FMEA is a systematic analysis of potential failure modes that aims to prevent product and process failures before they occur. FMEA focuses on preventing defects, improving safety, and increasing customer satisfaction. Although FMEA only focuses on processes and products, FMEA can also produce great benefits (Prienycha et al., 2023).

PT. Kedaung Indah Can, Tbk is a subsidiary of Kedaung Group which successfully listed its shares for the first time on the Jakarta Stock Exchange since 1993. This company was first established by Agus Nursalim since 1974 which is a manufacturer and exporter of canned/tin products and enamel steel cookware whose products include pots, pans, teapots, mugs, glass bowls, rice containers and several other household products. During the production process, problems often arise, namely a fairly high level of product defects. These defects often occur during the inspection process, namely the process before the product is handed over to consumers, the inspection section will check and test the product according to applicable standards and provisions. From the results of the inspection by the inspection section, it is known that defects that often occur in glass bowl products include cracked glass bowls, broken glass bowls, and untidy paint. This condition is very detrimental to the company because defective products will be reworked and the process will take a very long time and very high costs so that production costs will also increase. If production costs increase, the selling price of the product will also increase, so that the competitiveness of the product will certainly decrease.

Failure risk analysis is used to identify risks that occur in order to prevent failure. The purpose of risk analysis is to identify and assess potential risks that exist, so that action can be taken to reduce or eliminate the risk. By conducting this research, it is expected to be a basis for companies to identify risk factors that occur in companies in the process of increasing competitive advantage by knowing the potential impact to find the severity value, potential causes to find current events and control values to find detection values for all risks and calculate the Risk Priority Number (RPN). For this reason, it is necessary to identify the risks that occur in order to increase the competitive advantage of products and companies.

2. METHOD

This study aims to identify problems that occur in the glass bowl production process using the Failure Mode and Effect Analysis (FMEA) method. The stages of data analysis are as follows:

1. Identification of types of defects

At this stage, identification of types of defects is carried out to find out what types of defects are found in glass bowl products at PT. Kedaung Indah Can, Tbk.

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2. Identification of Critical to Quality (CTQ)

CTQ is used so that this research is more focused on the problems to be fixed. From the various CTQs that have been identified, one CTQ is selected that has the most significant influence on improving quality. The selection of CTQ is based on the analysis of the number of defects that occurred during September 2024. The tool used in this analysis is the Pareto diagram.

3. Identification of types of defects that have an influence (cumulative defect percentage)

At this stage, the types of defects will be sorted based on the level of dominance of their influence, from the largest to the smallest. To identify the types of defects that have the greatest influence, the Pareto diagram and cumulative defect calculation are used so that the cumulative defect percentage can be clearly seen.

4. Identify potential failure types with Pareto diagram

This stage collects data on the types of glass bowl defects where the defects are cracked glass bowls, broken glass bowls and uneven colors. After determining the type of failure, the next step is to rank them from the lowest to the highest value. Based on the results of the potential failure, the highest value will be used as a reference to be repaired.

5. Identify the causes of potential failures with a cause and effect diagram

Fishbone diagrams are used to identify the causes of product defects.

6. Calculate the RPN

Calculate the RPN value of each failure mode. The RPN value is used as a reference to prioritize potential handling that will arise.

$$RPN = Severity \times Occurrence \times Detection$$

Description:

Severity (S): How severe the impact of the failure is

Occurrence (O): How often the failure occurs

Detection (D): How likely the failure is to be detected

7. Determining action priorities

Based on the RPN value, identify failures with the highest risk and prioritize improvements to reduce the likelihood of failure.

8. Preparation of recommendations for corrective actions

At the stage of preparing recommendations for proposed improvements, the most feasible alternative solution will be selected to be implemented in the company. Including all resource limitations in the company, costs, time, and covering various other criteria.

9. Monitoring and evaluation

After the corrective actions are taken, re-evaluate the process to see if the RPN value has decreased. Make sure all steps and FMEA results are well documented.

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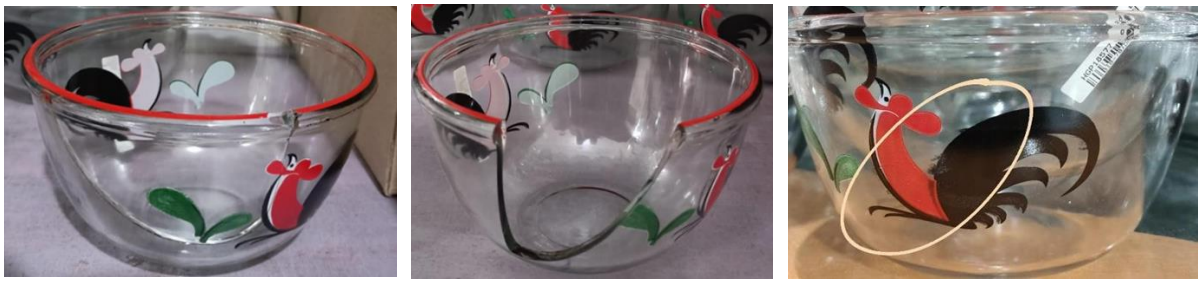
10. Conclusions and suggestions

At this stage, the results of data processing that have been carried out will be obtained to become recommendations and decision considerations for the company to reduce the risks that occur in the glass bowl production process at PT. Kedaung Indah Can, Tbk.

3. RESULT AND DISCUSSION

3.1 Defect Type Data on Glass Bowl Products



(a) **(b)** **(c)**

Figure 1. Defect Type. **(a)** Cracked Glass Bowl. **(b)** Broken Glass Bowl. (c) the color of the bowl is not neat

3.2 Defect Cummulative

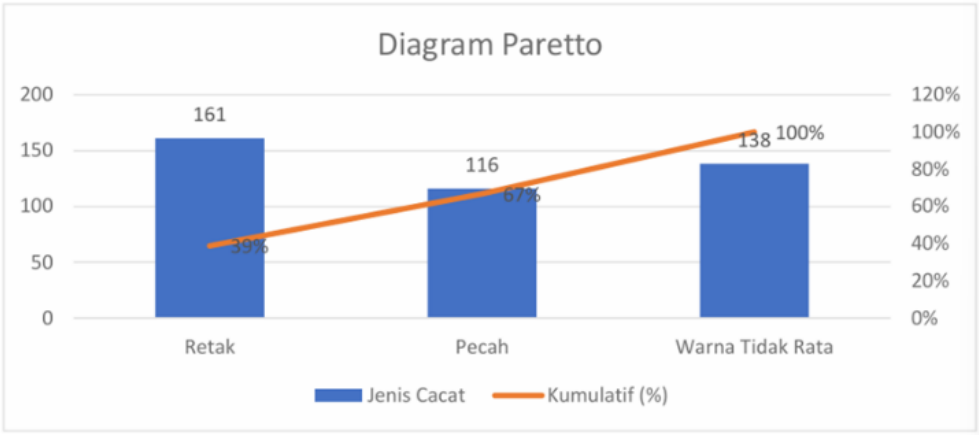
The first stage carried out in this section is to calculate the percentage of defect types in glass bowl products. The cumulative defect type table for glass bowls is as follows:

Table 1. Defect Cummulative

No.	Jenis *Defect*	Jumlah *Defect*	Percentage (%)	Cummulative (%)
1	Cracked	161	39%	39%
2	Broke	116	28%	67%
3	The color not neat	138	33%	100%
	Total	415	100%	

3.3 Pareto Diagram

Pareto diagram is a bar chart and block diagram that illustrates the comparison of each type of data to the whole.



(a)

Figure 2. (a) Pareto Diagram

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3.4 Calculate RPN

Table 2. Calculate RPN

Failure Mode	**S**	**O**	**D**	**(RPN) S*O*D**
Cracked	5	5	5	125
	4	4	5	80
	5	5	4	100
Broke	6	3	4	72
	7	3	7	147
	8	4	6	192
The color not neat	4	5	4	80
	5	4	5	100
	3	4	3	36

Defect	*Cause* with highest RPN	RPN	Total RPN
Broke	Pressure, impact & destruction	192	411
Cracked	Poor material quality	125	305
The color not neat	Spray machines often have problems	100	216

3.5 5W + 1H Concept

5W+1H analysis is a solution to provide a glass bowl production improvement plan based on cumulative RPN values. Based on the failure modes that have been prioritized based on the fishbone diagram, three main failure modes are obtained. The steps that must be taken are to use 5W+1H which aims to determine a quality improvement action plan based on (why - reason, where - where, when - when, who - person, how - how). The following is a table of improvement recommendations with the 5W+1H concept.

Table 3. Implementation 5W + 1H Concept

What	Why	Where	When	Who	How
Broke	Pressure, impact & destruction	Storage space	Storage process	Staff PT. Kedaung Indah Can, Tbk	Store in a safe, uncluttered place and avoid impacts.
Cracked	Poor material quality	Production room	Production process	Staff PT. Kedaung Indah Can, Tbk	Selection of high quality materials
Color not net	Spray machines often have problems	Production room	Painting process	Staff PT. Kedaung Indah Can, Tbk	Perform regular maintenance on the spray machine

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4. CONCLUSION

Based on data processing, the percentage of defects in glass bowl products at PT. Kedaung Indah Can, Tbk, namely the type of cracked bowl defect dominates the number. Of the total 415 defective products, 39% of them are cracked bowl defects, 28% broken bowls and 33% untidy bowl color defects which are then used as a reference in the repair analysis. Based on the fishbone diagram that has been made, it can be seen that the types of defects in glass bowl products occur due to 5 factors, namely the environment, humans, methods, materials, and machines. Where environmental factors are caused by uncomfortable conditions in the workplace, human factors are caused by workers' skills that are less skilled in making bowl products, material factors are caused by raw materials that do not meet specifications, machine factors are caused by the condition of the color spray machine which sometimes experiences trouble. And the last one that has the most influence is the method where the SOP is not implemented properly. Suggestions for improvement to reduce defects in glass bowl products at PT. Kedaung Indah Can, Tbk are as follows:

1. Conduct training for workers to be more motivated and accuracy in working can be improved.
2. Conduct a thorough re-check of the machines used in the glass bowl product production process.
3. Conduct material checks so that the quality standards used are in accordance with the standards set before being produced or distributed.
4. Comply with the applicable Standard Operating Procedure (SOP), so that the entire series or production process runs smoothly and in accordance with the standards set by the company.
5. Provide a comfortable work space, by adding a fan or air conditioner that can reduce the hot temperature in the room, and for equipment that is rarely used but is in the production area, it should be kept away and arranged neatly in a place according to its size and type.

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