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Safety Belt Product Quality Analysis To Analyze The Number of Defects Using The Seven Tools Method at PT. XYZ

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Abstract

PT XYZ is a company that operates in the automotive spare parts sector. The problem at PT XYZ is quality defects in safety belt part products. Based on these problems, its necessary to carry out an analysis of improvements in production so that it can produce quality products and reduce product defects.Seven tools are seven basic tools used to solve problems faced by production, especially problems related to quality. Quality improvement using seven tools can explain in detail the types of product defects and the causes of these product defects. Based on the data analysis that has been carried out, improvements are proposed to improve product quality, Get used to working accordingly SOP, Provide a place to products in a safe place, Familiarize workers to carry out periodic checks, Streamlining air circulation by creating vents, The head production provides a closed storage area, Instruct material suppliers to provide anti-rust coatingsBased on the data analysis that has been carried out, improvements are proposed to improve product quality, Get used to working accordingly SOP, Provide a place to products in a safe place, Familiarize workers to carry out periodic checks, Streamlining air circulation by creating vents, The head production provides a closed storage area, Instruct material suppliers to provide anti-rust coatings.

A. Introduction

In Indonesia, industrial growth is rapidly advancing, particularly amid the current era of globalization [1], [2], [3], [4]. Specifically, the manufacturing sector is experiencing heightened development, attributed to the rising consumer demand for these goods [5], [6], [7]. The paramount element for achieving success in today's globalized landscape is quality [8], [9], [10], [11]. Generally, every manufacturing entity prioritizes the quality of its output, recognizing that assured quality heightens consumer confidence and broadens market reach [12], [13], [14]. Consequently, various methodologies have emerged to establish optimal conditions within production processes, aiming for zero defects [15], [16]. Products of high quality typically align with consumer expectations, demonstrating dependable performance, longevity, and safety. Such products not only foster consumer trust in the brand and bolster loyalty but also mitigate the likelihood of returns or refunds, elevating the company's reputation in the eyes of consumers. Thus, product quality stands as a pivotal factor in cultivating customer satisfaction and sustaining a robust market presence.

PT. XYZ is a manufacturing company that produces automotive spare parts. Currently, the company is experiencing issues related to the high level of product defects and their frequent occurrence. Defective products that occur at PT XYZ include rust, chip, crack and dimensional defects. Given these challenges, it's imperative to conduct an analysis of production enhancements to ensure the production of high-quality products and minimize defects. A proficient production process is characterized by meeting predefined standards [17]. Nonetheless, in practice, deviations and impediments frequently arise, leading to product defects. One approach in quality control is statistical quality control [18], [19], [20].

In this research, the seven tools approach was utilized to address defects found in finished products, particularly in the components of safety belts. The Seven tools are highly suitable for analyzing the number of defects in products because these tools are specifically designed to assist in identifying, analyzing, and solving quality-related issues [21], [22]. These seven tools include simple statistical methods and data visualization techniques that can be used to understand the root causes of product defects, such as Pareto charts, cause-and-effect diagrams (fishbone), and control charts. By utilizing these seven tools, the quality team can conduct a comprehensive analysis of the production process to identify areas where improvements can be made to reduce the number of defects and enhance overall product quality.

B. Research Method

Quality

Quality is the main aspect that consumers consider when making a decision to buy or not a product [23]. Business actors are fully aware of this condition. Therefore, with all their efforts, business actors try to meet consumer needs by providing quality products. Often, companies equip the products they produce with various after-sales services to provide guarantees to consumers. Or, there are companies that provide various variants as alternative choices to consumers.

Seven Tools

Seven tools are seven basic tools used to solve problems faced by production, especially problems related to quality. Quality improvement using seven tools can explain in detail the types of product defects and the causes of these product defects [22].

Check Sheet

A check sheet is a simply designed sheet containing a list of things needed for data recording so that users can collect data easily, systematically and regularly when the data appears at the scene. Generally, this Check Sheet contains questions that are created in such a way that the note taker only needs to put a mark in the column provided, and provide information as necessary.

Data Stratification

After entering the data into the check sheet, the process of classifying the data into subgroups based on categories and characteristics is carried out with the aim of making data processing easier for the next stage. Stratification helps analyze data into meaningful categories or classifications to focus on corrective actions. Stratification can also use data grouping methods to group data into certain categories so that the data explains the problem clearly and makes it easier to draw conclusions.

Histogram

After the data on the check sheet is classified according to categories, the data can be processed by creating a histogram. The goal is to determine the distribution and shape of data patterns from the process. Histograms are a useful tool for determining process variability. In the form of a bar chart that shows a data table sorted by size. This data table is usually called a frequency distribution.

Pareto Diagram

After the data is classified, making a Pareto diagram aims to sort the data classification according to the highest to lowest ranking order, so that it can help find the most important problems and solve them immediately.

Scatter Diagram

The use of scatter diagrams can analyze data that already exists or has been previously processed as a follow-up analysis to determine whether existing causes have an impact on quality characteristics. A scatter diagram or scatter diagram is a method used to determine the relationship between two variables.

Control Chart

A control chart is a map used to study the process of change over time. Data is plotted in time series. The control chart consists of three horizontal lines, namely: Center line, the line that shows the middle value or average value of the quality characteristics plotted on the control chart.

Fishbone Diagram (Cause and Effect Diagram)
After understanding the main problem of product damage in the histogram, you can analyze the causes of damage to a product using a cause and effect diagram, making it possible to examine what factors cause product damage.

C. Result and Discussion

Check Sheet

A check sheet is a tool used to record the results of data collection and present the data in a communicative form so that it can be converted into information. The results of data according to the check sheet can be seen in table 1:

Table 1. Data on production quantities and product defects

Month	Production Data (Unit)	Rust Defect (Unit)	Chip Defect (Unit)	Crack Defect (Unit)	Dimensional Defect (Unit)	Total Defect (*Unit*)	% Defect/ month
March 2023	5536	269	199	59	87	614	11,09%
April 2023	5256	390	97	129	32	648	12,33%
Mei 2023	5812	515	76	49	52	592	10,19%
June 2023	5441	189	83	117	50	439	8,07%
July 2023	5039	137	88	55	42	322	6,39%
August 2023	5527	209	81	60	77	427	7,73%
Total	32611	1709	624	469	340	3042	

Data Stratification

Stratification is a stage for grouping data into groups that have the same characteristics. According to the data collected, the criteria set for defects in safety belt part products are rust defects, chip defects, crack defects and dimensional defects. The stratification results according to the check sheet are shown in table 2:

Table 2. Data Stratification

	Type of Defect			Total
Rust	Chip	Crack	Dimensional	
1709	624	469	340	3042
56,18%	20,51%	15,42%	11,19%	100%

Table 3. Characteristics of the Causes of Defects in Safety Belt Part Products

Type of Defect	Cause
Rust	Lack of maintenance on the press machine so that the machine is not in prime condition
Chip	The machine is dirty so the production process is not in good condition.
Crack	The engine was not lubricated according to procedures so the engine was dry
Dimensional	There is wear on the press machine

Histogram

A histogram is a bar diagram that depicts a number of data grouped into classes at certain intervals.

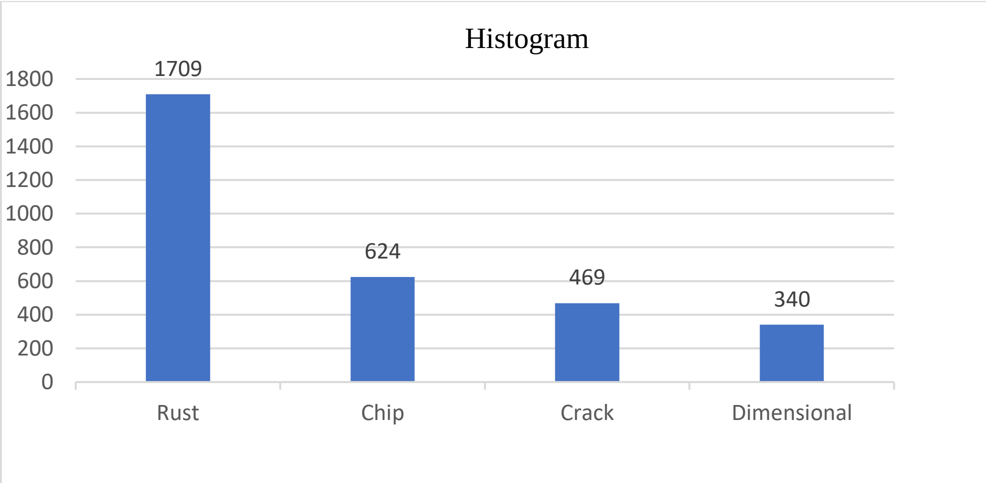

Figure 1. Histogram

Based on the results of the histogram above, it can be seen that the sequence of intervals for the type of each defect that occurs most often includes 1709 rust defects, 624 chip defects, 496 crack defects, and 340 dimensional defects.

Pareto Diagram

Pareto diagrams are bar graphs that are often used as an interpretation tool to order each type of defect from largest to smallest. After that, the percentage of defects is calculated and the cumulative percentage can be seen in table 4.

Table 4. Persentase Produk Cacat Safety Belt in March 2023

Order of Defect Types	Total Defect (unit)	Percentage *Defect* (%)	Cumulative Percentage (%)
Rust	269	43,81	43,81
Chip	199	32,41	76,22
Dimensional	87	14,17	90,39
Crack	59	9,61	100
Total	614		

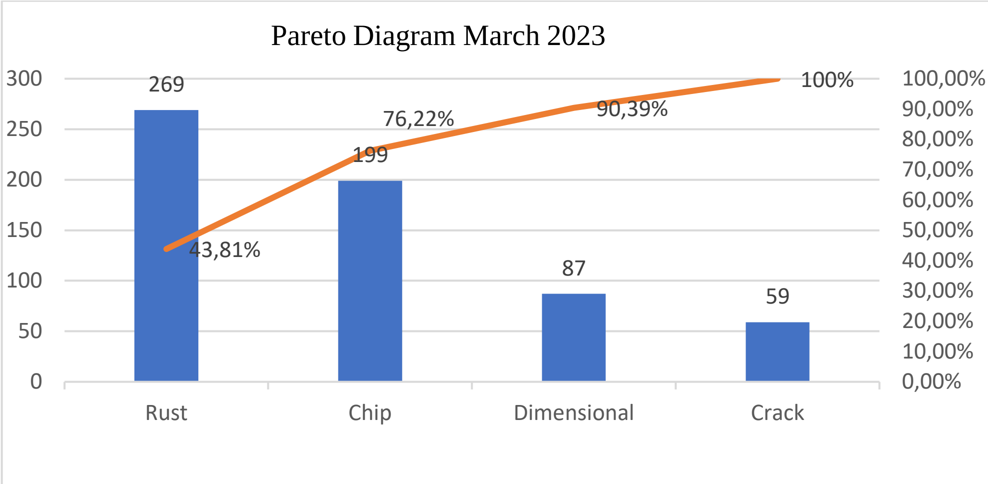

Figure 2. Pareto Diagram March 2023

Based on Figure 2. it can be seen that the most dominant type of defect in terms of cumulative percentage is rust defects with a percentage of (43.81%), followed by chip defects with a percentage of (32.41%), then dimensional defects with a percentage of (14.17%), and crack defects with a percentage of (9.61%).

Scatter Diagram

Scatter Diagrams are used to show the relationship or correlation between two measurements of defect-causing factors related to a characteristic. Based on the Pareto diagram, the dominant order of defects is rust defects, followed by chip defects, crack defects and dimensional defects.

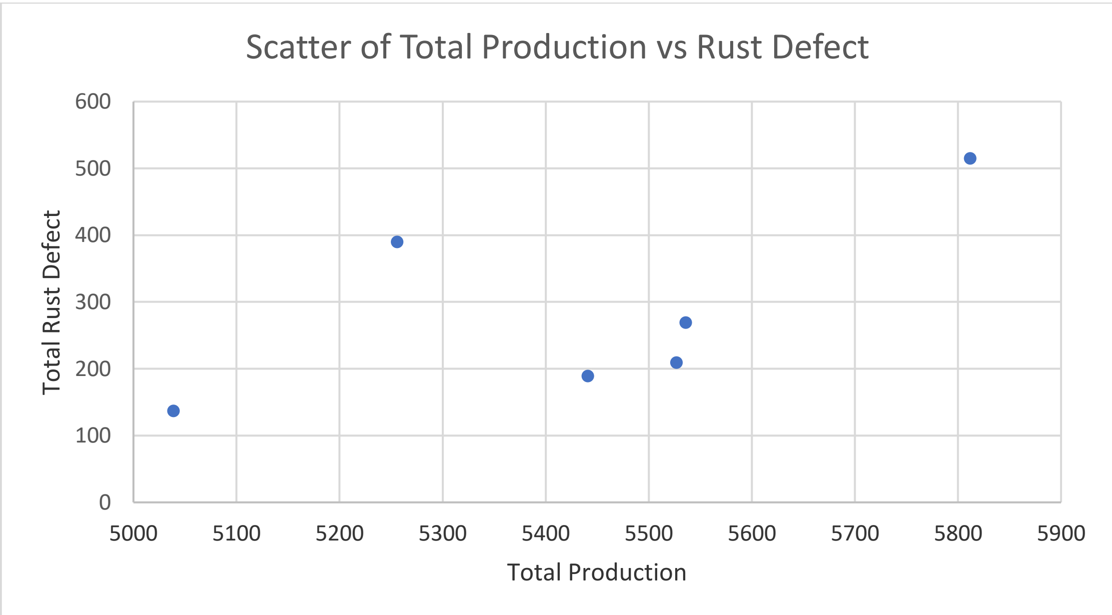

Figure 3. Scatter Diagram

Based on Figure 3. it shows that there is no correlation when there is an increase in variable X, namely the amount of production, it does not have a significant effect on variable Y, namely the number of defects. So that the rise and fall of production quantities does not affect the number of defects.

Control Chart

The P control chart serves to evaluate whether the process is stable or not, and also to identify fluctuations in the available data. Here is the mathematical equation used to create a P control chart.

$$P_1 = \frac{np_1}{n_1} \quad (1)$$
$$= \frac{269}{5536}$$
$$= 0{,}049$$

$$CL = \bar{P} =$$
$$= \frac{1709}{32611}$$
$$= 0{,}052$$

$$UCL = \bar{P} + 3\sqrt{\frac{\bar{P}\ (1-\bar{P})}{n}} \quad (3)$$
$$= 0{,}052 + 3\sqrt{\frac{0{,}052\ \ (1-0{,}052)}{5536}}$$
$$= 0{,}061$$

$$LCL = \bar{P} - 3\sqrt{\frac{\bar{P}\ (1-\bar{P})}{n}} \quad (4)$$
$$= 0{,}052 - 3\sqrt{\frac{0{,}052\ (1-0{,}052)}{5536}}$$
$$= 0{,}043$$

The summary of the proportion value of the rust defect can be seen in Table 5 below.

Table 5. The Proportion of Rust Defect

Month	Inspection Total	Rust	P	CL	UCL	LCL
March	5536	269	0,049	0,052	0,061	0,043
April	5256	390	0,074	0,052	0,062	0,043
Mei	5812	515	0,089	0,052	0,061	0,044
June	5441	189	0,035	0,052	0,061	0,043
July	5039	137	0,027	0,052	0,062	0,043
August	5527	209	0,038	0,052	0,061	0,043
Total	32611	2741	0,052			

Based on rust defect data, it will produce a graph according to the image below:

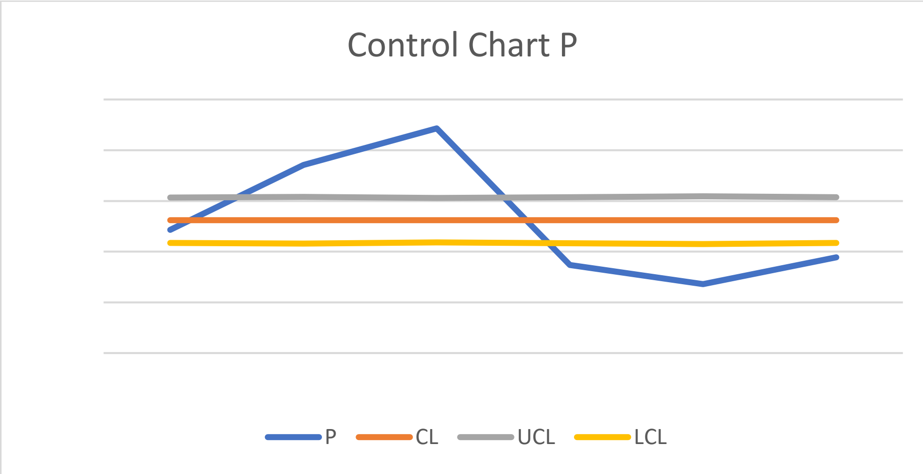

Figure 4. Control Chart

From the graphic results above, there are five points that are out of the upper control limit and lower control limit, namely April, May, June, July and August. This shows that controlling rust defects is still experiencing many problems. Therefore, further analysis is needed regarding the causes of deviations seen on the P control chart. Factors causing the process to be uncontrolled will be analyzed using a fishbone diagram.

Fishbone Diagram

Fishbone diagrams or cause and effect diagrams are useful for analyzing and finding out the most dominant factors that occur. At this stage, an analysis of the causes of rust defects, chip defects, crack defects and dimensional defects is carried out using a fishbone diagram

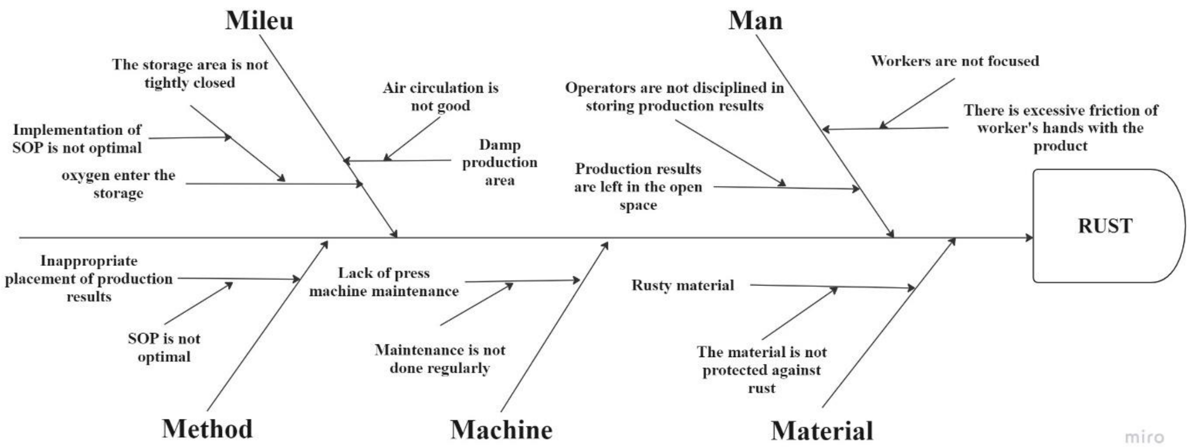

Figure 5. Fishbone Diagram

The Following is an explanation of the fishbone diagram:

1. Milieu factor

   On the milieu factor, namely the product storage area is less closed and the production area is damp which causes the product to become rusted

2. Man factor
   In the human factor, namely and worker errors in storing production result in open spaces and excessive friction of the worker's hand with the product which causes the product to rust easily
3. Method factor
   On the method factor, namely the lack of precision in the method of storing productionresults that do not use the SOP
4. Machine factor
   On the machine factor, namely the lack of machine maintenance press
5. Material factor
   On the material factor namely, the material obtained from the supplier is not given anti rust so during the delivery process from the supplier to the company the material is easily rusted.

After the sources and root causes of the problem are identified, it is necessary to make an improvement plan to reduce the total rust defect in table 6.

Table 6. Improvement

Factors causing the problem	The root of the problem	The impact of the root cause	Troubleshooting (Proposed Improvements)
Man	Too much friction between workers' hands and their products	The product is easily rusted.	Get used to working accordingly Standard Operating Procedure (SOP)
	Production results are left in the open by workers	The impact of the lack of discipline of the workers is that the product is placed in an open space so that the product can rust.	Provide a place to store products in a safe and sterile place.
Machine	Lack of machine maintenance press	The impact on the production process is not running well and indicates defective production results.	Familiarize workers to carry out periodic checks
Milieu	Damp production area	In a humid production area, it can cause workers to be distracted which hinders the production process.	Streamlining air circulation by creating air vents
	The product storage area is not tightly closed	Air can enter and cause the product to rust	The head of the production provides a closed storage area
Method	Inappropriate placement of production results	The impact of production is easy to rust	Provide a safe storage place for produce.

Material	Material not coated with anti-rust	Because the material is not coated with anti-rust during the production process from raw materials (materials) to finished products it is easier to rust.	Instruct material suppliers to provide anti-rust coatings.

D. Conclusion

Based on the data processing and analysis that has been carried out, to reduce defects in safety belt production, improvements are proposed to improve product quality. The first improvement is working accordingly Standard Operating Procedure (SOP). By working according to the SOP, the likelihood of errors occurring that could lead to defects will be reduced. Provide a place to store products in a safe and sterile place because storing products in appropriate areas, it helps prevent them from rusting. Periodic maintenance of production machinery can decrease the frequency of disruptions, which are a major factor leading to defects in the resulting products. Providing good air ventilation can facilitate smooth production processes. Providing a closed storage area helps to minimize the risk of product contamination, which can lead to premature product wear. Additionally, it is necessary to procure rust-resistant lining materials to prevent spare parts from easily rusting.

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