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Reducing the rust defect rate of K59 cap fuel filler products in the progressive pressing line using the DMAIC method

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Abstract

This research aims to find out how to apply the method to help analysed problems, identify the causes of problems in the production of Cap Fuel Filler K59 at Company defect level in production results. Determining the selected data using purposive techniques. Data collection was carried out by collecting primary and secondary data through literature studies, field studies, observations, interviews and documentation. The data analysis procedure was carried out using the DMAIC method (define, measurement, analyze, improvement and control). After data analysis, improvement efforts are carried out with the following actions: (1) making special placements for re-delivery parts; (2) changing the plastic layer to paper as a base that covers the surface of the box; (3) give skates to the parts in the box in the amount of 2 pcs/column; (4) adding a rust category to the Q-point to be posted in the production and checking area. After carrying out these improvement actions, the number of defects in the products produced decreased and this was indicated by an increase in the sigma value from 3.6% to 3.9%.

1. INTRODUCTION

The automotive industry is one of the main sectors in the global economy that continues to develop. The need for motor vehicles, both for personal and commercial modes of transportation, makes this industry very important in providing safe, reliable, and efficient high-quality products. The automotive industry includes not only the production of motor vehicles, but also automotive components, such as engines, transmissions, and other spare parts. Indonesia itself has become one of the largest automotive markets in Southeast Asia, with significant growth in recent decades and making this industry one of the mainstay sectors in the economy that has a considerable contribution to the national economy (Menperin dalam Komisi Pengawas Persaingan Usaha, 2021). It can be predicted that the automotive industry in Indonesia will continue to advance in line with the development of technology and the production system that supports it. The growing market segmentation in the automotive industry will certainly increase the level of competition as well. The quality of products and services is a very important factor in market competition which is generally used as a standard and comparative factor between

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Available online 15 October 2024 / © 2024 The Authors. Published by Jurnal Teknik Industri Terintegrasi Universitas Pahlawan Tuanku Tambusai. This is an open access article under the CC BY-SA license (https://creativecommons.org/licenses/by-sa/4.0)

products and services from various manufacturers. In the ISO 9000 standard, quality is defined as the comprehensive characteristics of a product or service that affect the extent to which the product is able to meet a specific need (Andriyani & Zulkarnaen, 2017). Sitohang & Rifqah (2021) In general, manufacturing companies use two techniques to maintain and improve quality: Quality Control (QC) and Quality Assurance (QA). The goal of both techniques is to ensure that the output produced meets the established quality requirements and standards. Product quality in the automotive industry plays a crucial role because it significantly affects user safety, customer satisfaction, and brand reputation. Low-quality products can lead to accident risks, high repair costs, and decreased consumer trust in the brand.

Company XYZ is one of the companies in Bekasi Regency that operates in the automotive sector. The products manufactured are automotive components for two-wheeled and four-wheeled vehicles. Not only does it sell domestically, but company XYZ also exports abroad; therefore, the products produced must meet high-quality standards. Recently, company XYZ experienced production problems, particularly in the progressive pressing dies process. The issue encountered was a high defect rate in the Cap Fuel Filler K59 produced during the period from June 2023 to December 2023. The Cap Fuel Filler K59 is a critical component in the fuel filling system of motor vehicles. This component is located near the vehicle's fuel inlet and functions as a secure cover for fuel filling access. The Cap Fuel Filler K59 is typically made of metal materials, such as aluminum or stainless steel, to ensure strength, corrosion resistance, and safety in daily use. It must meet strict tolerances to ensure compatibility with the vehicle and the fuel filling system. Its design is intended to comply with stringent standards regarding fuel filling safety and user convenience. Despite its small size, the Cap Fuel Filler K59 plays an essential role in the safety and comfort of vehicle use. High product quality and adherence to strict technical specifications are key to meeting consumer expectations and industry regulations. Therefore, the production of the Cap Fuel Filler K59 is an integral part of the automotive supply chain, which demands precision in design, materials, and manufacturing processes to produce a product that is safe, reliable, and efficient. Defects in the Cap Fuel Filler K59 will become a serious issue that can impact the quality, safety, and performance of the component in vehicle applications. The high-quality standards required by customers for export batches of the Cap Fuel Filler K59 have become one of the company's priorities, necessitating stricter quality control during its production process.

In this study, the researcher uses tools to collect and analyze data, namely a checksheet to present data, a Pareto chart to identify defects with the highest percentages, a histogram to determine frequently occurring defects, a control chart to identify the control limits of a process, and a fishbone diagram to identify the factors causing defect appearance. Based on the aspects described above, the researcher will conduct a study titled "Reducing the Rust Defect Rate on Cap Fuel Filler K59 Products in the Progressive Pressing Line Using the DMAIC Method." Through this research, the researcher aims to analyze the issues related to product defects in the Cap Fuel Filler K59 on the progressive pressing line and design follow-up actions or improvements for quality control to reduce the product defect rate using the DMAIC method.

2. METHODS

Data collection is a systematic stage carried out to obtain relevant data and information from various sources, which will then be analyzed and conclusions drawn. The data collection methods used in this study include both primary and secondary data. Primary data collection is conducted through direct observation in the production area of the Cap Fuel Filler K59 on the progressive pressing line. This data collection aims to obtain data on production volume and product defects (before and after improvement) over nine months, from July 2023 to March 2024. In this study, data processing and analysis are carried out using the DMAIC method, which includes the stages of Define, Measure, Analyze, Improve, and Control.

Conducting an analysis of the cause-and-effect factors of the problems encountered is an essential step that cannot be overlooked in any research. This step is crucial because it aims to identify the actual root causes of the problem, which then serve as a basis for improvement efforts. If the root cause analysis is conducted accurately, the improvement solutions implemented will yield optimal results. Conversely, if the root cause is not accurately identified, the proposed solutions will not be effective in addressing the existing issues. Therefore, to facilitate the cause-and-effect analysis of this problem, the researcher will use a commonly employed method—the fishbone diagram method.

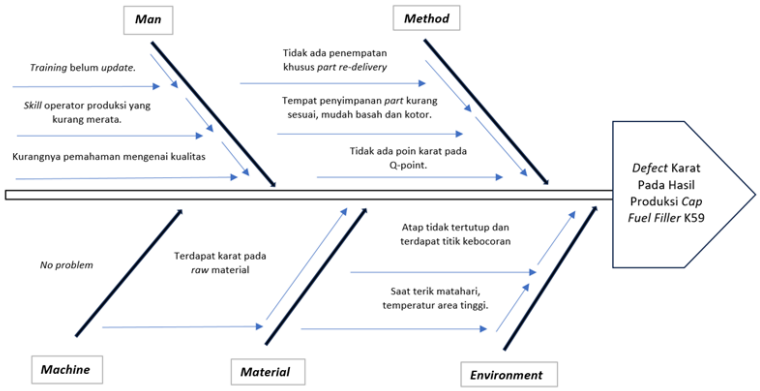

Fig. 2. Fishbone Rust Defect Diagram On K59 Fuel Filler Cap

3. RESULT AND DISCUSSION

Here is the data on the production results of other automotive components and the production data of the Cap Fuel Filler K59 at company XYZ over a six-month period from July 2023 to December 2023:

Table 1. Production Data of Other Components for the Period of July – December 2023

Nama Part	Juli		Agustus		September	
	jumlah produksi	jumlah NG	jumlah produksi	jumlah NG	jumlah produksi	jumlah NG
Holder Pillion	111.105	1086	115.470	1387	112.250	1107
Stoper Handle Lock	97.000	731	89.600	627	96.000	709
Washer	154.230	4345	156.010	4376	148.700	4286
Spring Guide 581	126.100	2273	130.240	2522	126.660	2205
Separator	83.420	1166	86.880	1177	84.980	1143
Total	571.855	9601	578.200	10089	568.590	9450

Nama Part	Oktober		November		Desember	
	jumlah produksi	jumlah NG	jumlah produksi	jumlah NG	jumlah produksi	jumlah NG
Holder Pillion	117.560	1435	113.554	1241	115.230	1319
Stoper Handle Lock	100.010	915	98.200	788	99.050	897
Washer	159.450	4402	150.900	4313	155.700	4355
Spring Guide 581	127.860	2371	125.430	2181	131.210	2680
Separator	83.070	1075	85.540	1133	87.000	1292
Total	587.950	10198	573.624	9656	588.190	10543

Table 2. Production Data of Other Components for the Period of July – December 2023

Bulan (2023)	Jumlah Produksi	Jenis *Defect*				Jumlah *Part* Cacat
		Karat	*Dent*	*Scratch*	*Crack*	
Juli	78.510	4.866	1.781	1.170	277	8.094
Agustus	76.430	4.780	1.455	1.024	200	7.459
September	75.000	4.665	1.630	987	187	7.469
Oktober	75.620	4.852	1.483	1.000	253	7.588
November	77.900	4.635	1.612	1.013	223	7.383
Desember	78.120	4.767	1.582	1.113	246	7.708
Total	461.580	28.565	9.543	6.307	1.386	45.701

Based on the data in the table above, it can be seen that during the period from July to December 2023, the number of defect appearances for the Cap Fuel Filler K59 on the progressive pressing line remains relatively high compared to the defect rate in the production of other components. The most common type of defect in the Cap Fuel Filler K59 is rust, with a total of 28,565 pieces affected out of the entire production volume during that period. This number is certainly not insignificant and will impact the overall quality level of the products produced. Therefore, improved quality control measures are needed to reduce the number of product defects.

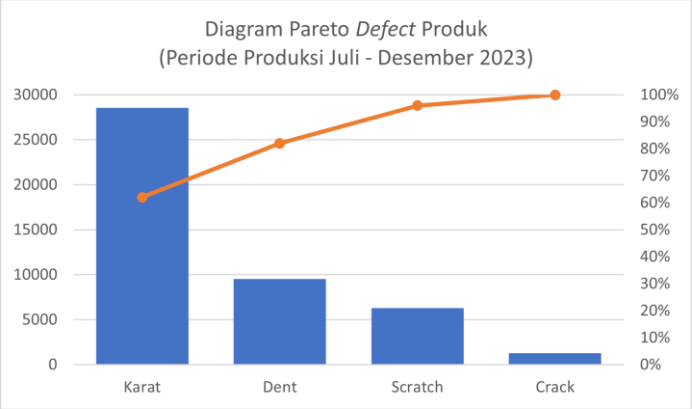

Fig. 1. Pareto Defect Product Cap Fuel Filler K59 Diagram (Production Period July – December 2023).

Based on the data in the diagram above, it is known that there are four types of defects from the most to the least. The highest type of defect is rust with a total of 28,565 pcs and the lowest type of defect is crack with a total of 1,286 pcs during the six months of production (July – December 2023). Based on the information seen in the diagram, the results have not reached the standards expected by the company. In an effort to improve quality and reduce the number of product defects, it is necessary to apply the right methods that intensively lead to quality control by understanding the company's production system thoroughly.

The operational steps in a Six Sigma quality improvement program involve selecting and determining Critical to Quality (CTQ) characteristics that are directly related to the specific needs of customers, developing a data collection plan through measurement, and measuring performance within the process. Based on the calculations, it is known that the capability of the Cap Fuel Filler K59 production process is relatively safe but not yet optimal, so efforts are needed to improve quality. This can also be observed through the relatively high DPMO (Defects Per Million Opportunities) value of 15,000, which, when converted to a sigma level, equals 3.67σ. This means that out of one million opportunities, there are 15,000 potential product defects that could occur in the production process.

4. CONCLUSION

Based on the causal analysis that has been carried out using a fishbone diagram, the researcher also analyzes the causal factors that will be presented in the table. This can be used as a strategic stage in developing continuous improvement steps (Improving Continuous) in the next process.

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