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The Application of Seven Tools to Improve Quality and Prevent Defects in the Instrument Panel Production Process at PT. Automotive Industry

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Abstract
Product quality is an important factor in the automotive industry, because defective products can reduce production efficiency, increase costs, and reduce customer satisfaction. This study aims to identify the dominant types of defects and analyze the main causes of defects in the Instrument Panel production process at PT. Industri Otomotif by applying the Seven Tools method. The research method uses a case study approach with data collection through direct observation, interviews, and production data documentation. The analytical tools used include check sheets, flowcharts, histograms, scatter diagrams, control charts, Pareto charts, and fishbone diagrams. The results show that there are four main types of defects, namely shot mold, bubble, burry effect mold broken, and discolor (striped), with the dominant defect being shot mold at 38.52%. Further analysis using the fishbone diagram revealed that the main causes of defects come from machine, method, material, and human factors. The application of the Seven Tools has proven effective in providing a comprehensive overview of production conditions and generating improvement recommendations that can reduce the level of defects, improve product quality, and reduce production costs.
Keywords: *product quality, seven tools, production, analytical tools, quality improvement*

Abstrak
Kualitas produk merupakan faktor penting dalam industri otomotif, karena produk cacat dapat menurunkan efisiensi produksi, meningkatkan biaya, serta mengurangi kepuasan pelanggan. Penelitian ini bertujuan untuk mengidentifikasi jenis cacat dominan dan menganalisis faktor penyebab utama cacat pada proses produksi Instrument Panel di PT. Industri Otomotif dengan menerapkan metode *Seven Tools*. Metode penelitian menggunakan pendekatan studi kasus dengan pengumpulan data melalui observasi langsung, wawancara, serta dokumentasi data produksi. Alat analisis yang digunakan meliputi check sheet, flowchart, histogram, scatter diagram, control chart, Pareto chart, dan fishbone diagram. Hasil penelitian menunjukkan bahwa terdapat empat jenis cacat utama, yaitu shot mold, bubble, burry effect mold broken, dan discolor (belang), dengan cacat dominan adalah shot mold sebesar 38,52%. Analisis lebih lanjut menggunakan fishbone diagram mengungkap bahwa penyebab utama defect berasal dari faktor mesin, metode, material, dan manusia. Penerapan *Seven Tools* terbukti efektif dalam memberikan gambaran menyeluruh mengenai kondisi produksi serta menghasilkan rekomendasi perbaikan yang dapat menurunkan tingkat kecacatan, meningkatkan kualitas produk, dan menekan biaya produksi.
Kata Kunci: *kualitas produk, tujuh alat, produksi, alat analisis, peningkatan kualitas*

1. Introduction

Product quality is a crucial aspect in the automotive manufacturing industry, as low quality standards can lower customer confidence and negatively impact a company's competitive advantage [1]. In the production process, product defects or defects often appear as problems that must be overcome in order to maintain the company's efficiency, productivity, and reputation [2]. Without effective quality control, defective levels can lead to scrap, rework, and production delays that disrupt overall operations [3]. Several studies have shown that identifying the types of product defects is an important first step to making quality improvements [4]. For example, in the agricultural products, MSMEs, and light manufacturing sectors, quality control methods using Seven Tools successfully identified the dominant defects and the most frequently emerging defect categories [5]. By knowing the types of defects, companies can focus efforts on the defects that have the greatest impact on product quality and cost [6].

Furthermore, the analysis of the factors causing the defect is an important stage so that the solution taken is right on target [7]. Methods such as fishbone cause-and-effect diagrams, check sheets, and histograms are often used in the context of the Seven Tools to explore the root causes of the human, machine, material, method, and environmental aspects [8]. The accuracy of the identification of the root cause greatly determines the effectiveness of the remedial intervention [9]. In addition, data collection and monitoring over a certain period of time are statistically important to know the variability of the process and whether the process is in control [10]. Tools such as control charts and scatter diagrams in Seven Tools facilitate monitoring of process fluctuations, correlations between variables, and help predict possible future defects [11].

Studies have also shown that the implementation of Seven Tools not only helps identify and analyze defects, but also provides concrete recommendations for improvements, such as machine maintenance, operator training, adjustment of working methods, and control of the production environment [12]. In some cases, the use of Seven Tools accompanied by Kaizen or a continuous improvement approach has significantly reduced the number of defects [13]. Especially for the plastics and automotive components industry that use processes such as injection, molding, staining, finishing, surface, and dimension control are factors that are often the dominant source of defects [14]. For example, research on plastic cardboard box products, the product is tempeh (although not automotive), but surface defect treatment, shrinkage, color mismatch, and similar dimensions are also found in the production of automotive components [15].

At PT. The Automotive Industry, which manufactures instrument panels, factors such as painting, spraying, surface finishing and dimensional control are essential. The instrument panel is not only its appearance (color, surface), but also its function, safety, and dimensional stability to match the vehicle's specifications. Therefore, the systematic and complete application of methods such as Seven Tools becomes relevant and necessary. Previous literature provides the basis that Seven Tools can be applied to plastic processes, painting, surface processing, finishing and dimensional control that have similar defective characters. This research has two main objectives, namely to identify the types of defects or defects that most often occur in the production process of Instrument Panel at PT. Automotive Industry; and analyze the main causative factors of the defect using the Seven Tools method. Thus, it is hoped that the results of this study will provide applicable repair recommendations, which will not only reduce the level of defects, but also improve the efficiency of the production process, reduce scrap/rework costs, and increase customer satisfaction.

2. Material and Methods

This research uses a case study approach with the object of Instrument Panel products at PT. Automotive Industry. The main focus of the research is the application of Seven Tools in order to improve product quality while minimizing the occurrence of defects in the production process. The scope of research includes the stages of design, raw material procurement, printing, assembly, and final testing, so that the entire process flow can be analyzed thoroughly. The selection of objects is based on the strategic role of PT. The Automotive Industry as a manufacturer of automotive components, where the achievement of high quality standards is an important factor to meet the demands of the industry as well as customer satisfaction.

The research materials are in the form of production data, defect records, and literature related to quality control techniques. The analysis tools used include a check sheet, flowchart, Pareto chart, and statistical software to support the analysis. This research was carried out directly in the production environment of PT. Automotive Industry, so that the data obtained is actual and representative. Data collection was carried out through two main methods, namely literature studies and field studies. Literature studies aim to obtain a theoretical foundation through the study of scientific journals, articles, textbooks, and related literature. The field study was carried out through direct observation of the production process, interviews with operators and production staff, as well as documentation of the company's primary and secondary data. To obtain comprehensive results, this study combines quantitative and qualitative methods. Quantitative methods are used in processing numerical data for statistical analysis, while qualitative methods are used to explore contextual information related to field conditions and production constraints.

Data processing is carried out systematically by applying seven tools. Flowcharts are used to map production flows, check sheets for real-time recording of defects, Pareto charts to determine repair priorities, and other tools for root cause analysis. The data obtained were then evaluated comparatively by comparing the initial conditions and results after the implementation of improvement recommendations.

Data analysis is carried out by integrating manual calculations and statistical software to verify the accuracy of the results. The analysis stage continues with a discussion that connects the findings with the research objectives, so that a comprehensive understanding of the effectiveness of the application of seven tools can be obtained. The entire stage of research starts from preliminary studies, identification of objects and problems, data collection, processing and analysis, to drawing conclusions and preparing recommendations. With this method, the research is expected to make a practical contribution to quality control in the automotive manufacturing industry. In conducting research with the Seven Tools method, there are research steps that must be taken to help in the process of solving the problems raised in the research where these steps can be described with a research flowchart.

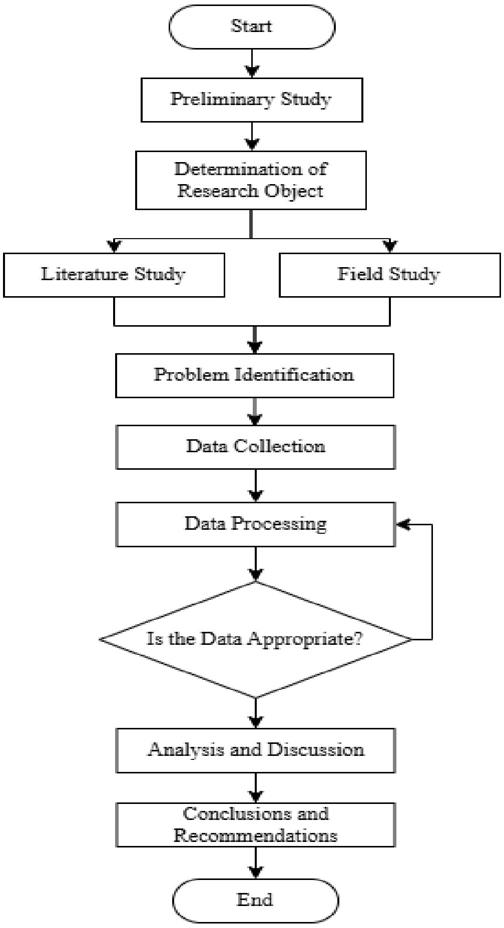

Fig. 1: Research Flow
Source: Author's Processing Results, 2025

3. Results and Discussion

Check sheet

It serves to group the data obtained during the processing process, thereby making it easier in the stages of data collection and analysis. Below is the data processing, namely the check sheet in Table 1. Check Sheet.

Table 1. Check Sheet

The Month	Production Quantity (Units)	Number of Defective Products (Units)	Types of Defects			
			Bubble	Discolor (Importance)	Shot Mold	Burry Efect Mold Broken
8	1847	110	27	13	40	30
9	1921	109	29	18	37	25
10	1848	114	24	15	55	20
11	1940	79	21	10	36	12
12	1958	115	35	25	35	20
Total	**9514**	**527**	**136**	**81**	**203**	**107**

Source: Author's Processing Results, 2025

Stratification

Based on the results of the data processing of check sheets, the classification of defective product types can be carried out. The stratification in instrument panel products is divided into 4 categories:

a. Shot Mold: Based on the recapitulation of the number of defects that occur in the production process, the most common type of defect is the shot mold. There are 203 defective products that have shot mold defects.

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b. Bubble: The second most common type of defect after the shot mold, which is bubble defect. There are 136 defective products that have experienced bubbles.
c. Burry Effect Mold Broken: The third most common type of defect after Bubble is Burry Effect Mold Broken. There are 107 defective products that suffer from burry effect mold broken.
d. Discolor: The fourth most common type of defect is discolor defect. There are 81 defective products that suffer from discolor.

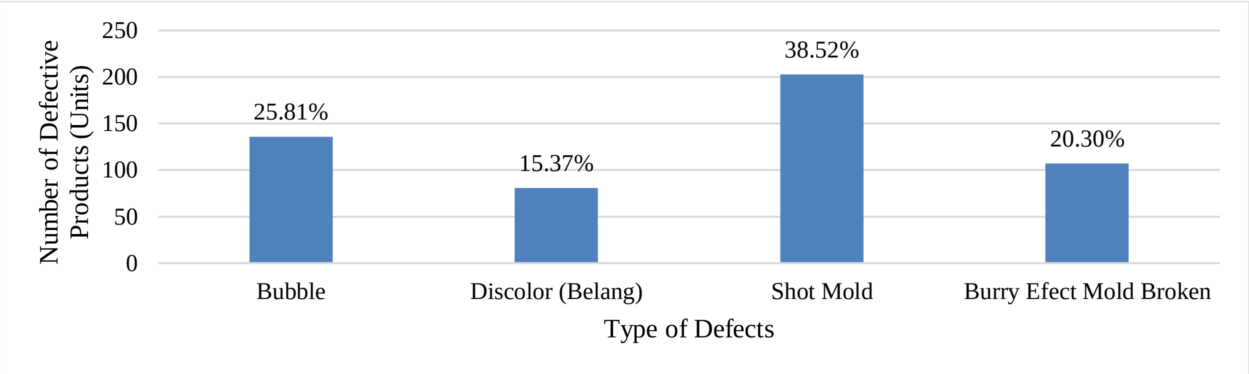
Histogram

A histogram is a visual tool in the form of a bar chart that is used to illustrate a frequency distribution, i.e. showing how often each value in a data set appears. Below is Table 2. Data Processing for Histograms.

Table 2. Data Processing for Histograms

No.	Types of Defects	Number of Defective Products (Units)	Percentage
1	Bubble	136	25,81%
2	Discolor (Importance)	81	15,37%
3	Shot Mold	203	38,52%
4	Burry Effect Mold Broken	107	20,30%
	Total	**527**	**100%**

After the data is processed into a table, the data is then created into a histogram (bar chart) in **Figure 2,** Histogram of Defective Products below.



. **Fig. 2**: Histogram Produk Cacat
Source: Author's Processing Results, 2025

Scatter Diagram

Scatter Diagrams are used to identify the extent to which environmental factors influence the number of defects or defects in the product. The data is processed into Table 3. Data Processing for Scatter Diagrams.

Table 3. Data Processing for Scatter Diagrams

Production Quantity (Units)	Number of Defective Products (Units)
1847	110
1921	109
1848	114
1940	79
1958	115

Source: Author's Processing Results, 2025

From the table above, then the data is processed into a scatter diagram in **Figure 3**. Scatter Defective Product Diagram below.

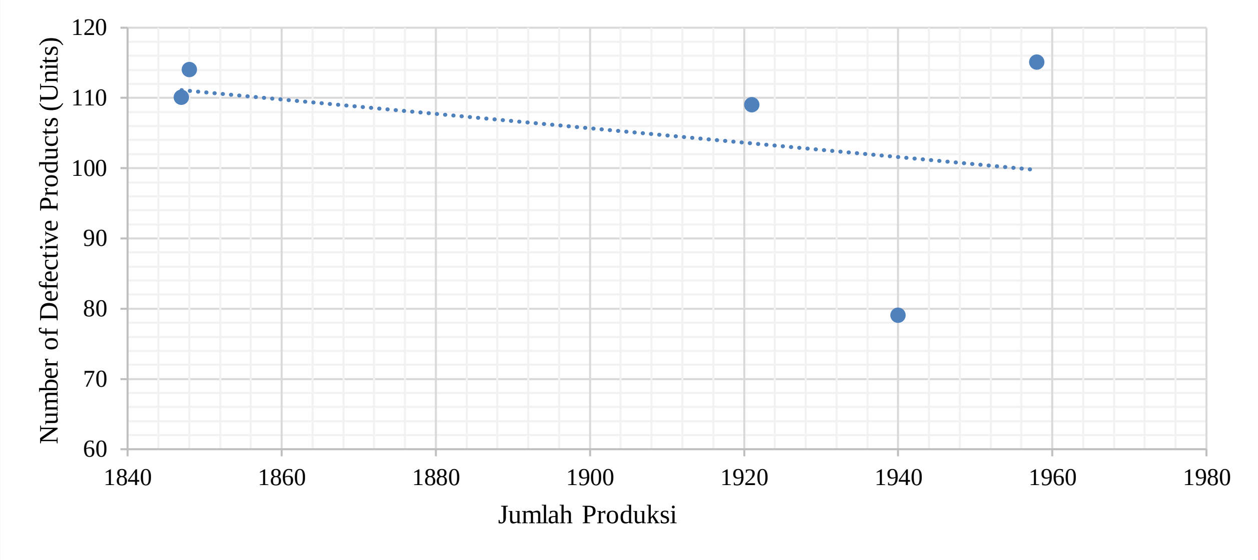


Fig. 3: Scatter Diagram of Flawed Products
Source: Author's Processing Results, 2025

Control Chart

By knowing the conditions of the production process based on the number of deviant products, the proportion of non-conformity of instrument panel products can be calculated. This control chart also serves to evaluate whether the level of defect that occurs is still within acceptable control limits. The data was processed first to obtain the proportion, central line, upper control limit, and lower control limit in **Table 4** Data Processing for Control Chart below.

Table 4. Data Processing for Control Chart

Month To-	Production Quantity (Units)	Number of Defective Products (Units)	Proportion of Defects	CL	UCL	LCL
8	1847	110	0,0596	0,0554	0,0714	0,03942
9	1921	109	0,0567	0,0554	0,0710	0,03974
10	1848	114	0,0617	0,0554	0,0714	0,03943
11	1940	79	0,0407	0,0554	0,0710	0,03981
12	1958	115	0,0587	0,0554	0,0709	0,03988
Total	**9514**	**527**				

Source: Author's Processing Results, 2025

After obtaining the proportion of defects, CL, UCL, and LCL, it is then made into a control chart in **Figure 4** Defective Product Control Chart below.

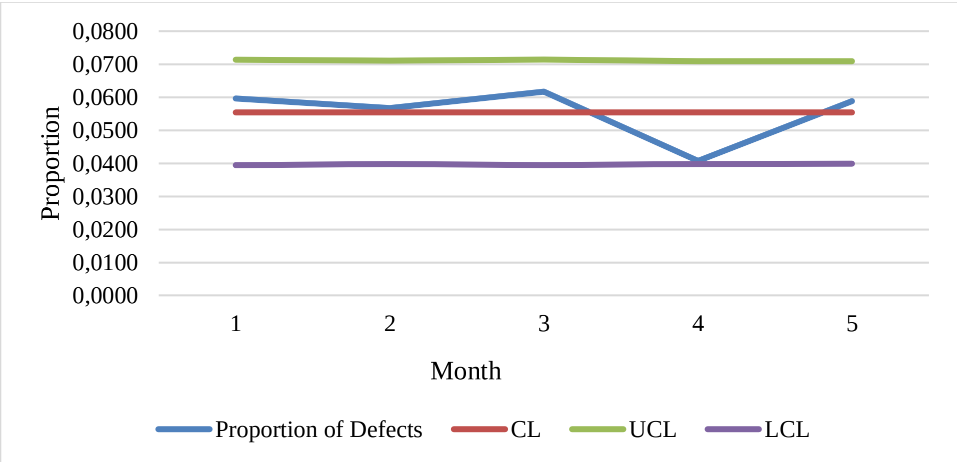


Fig. 4: Control Chart of Defective Products
Source: Author's Processing Results, 2025

Paretto Chart

Pareto chart is used to identify the most dominant type of defect in pants products produced by PT. Automotive Industry. The data is processed first as shown in **Table 5,** Data processing for the Pareto Chart below.

Tabel 5. Data Processing for Pareto Chart

No	Types of Defects	Qty Defects	Percentage	Cumulative	Priorities
1	*Bubble*	136	25,81%	25,81%	2
2	*Discolor*	81	15,37%	41,18%	4
3	*Shot Mold*	203	38,52%	79,70%	1
4	*Burry Effect Mold Broken*	107	20,30%	100,00%	3
Total		**527**	**100%**		

Source: Author's Processing Results, 2025

After the data is processed, then create *a Pareto chart*, as shown in **Figure 5** *Pareto Chart* of Defective Products.

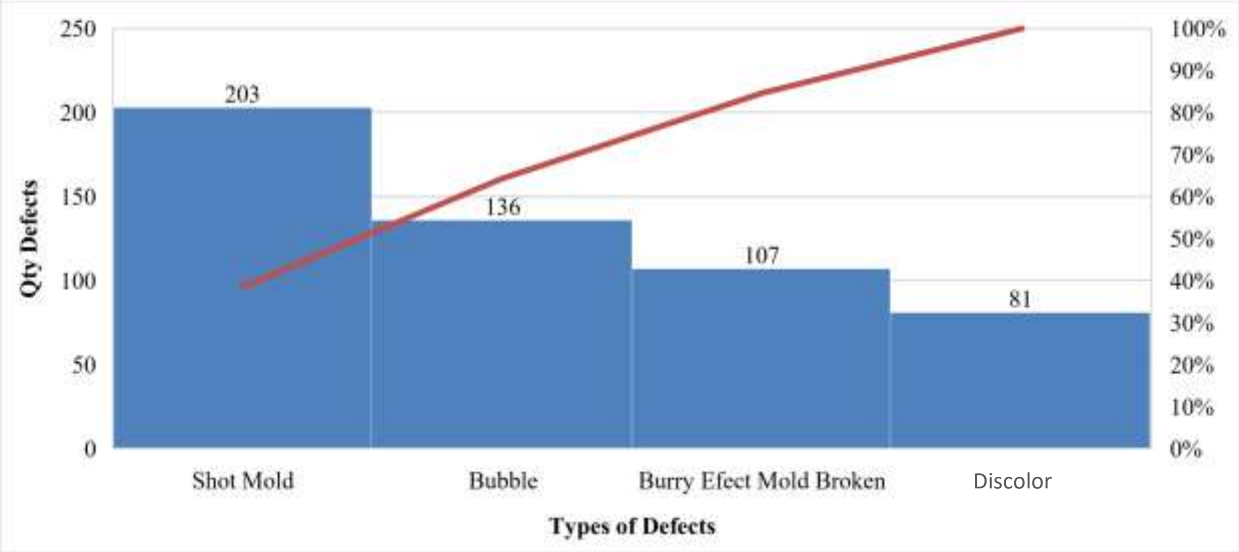


Fig. 5: Pareto Chart of Defective Products
Source: Author's Processing Results, 2025

Fishbone Diagram

Fishbone diagrams are used to analyze the factors that cause defects in the product. Based on the results of interviews and observations of workers, a number of causes of defects in pants products were found. Through a thorough investigation of the production process, both before and during production, various factors causing defects were successfully identified. These factors are then systematically outlined in the fishbone diagram.

a. *Shot Mold*

For the consequences of shot mold defects, the following is the identification of the causes in F**igure 6** Fishbone Diagram Shot Mold.

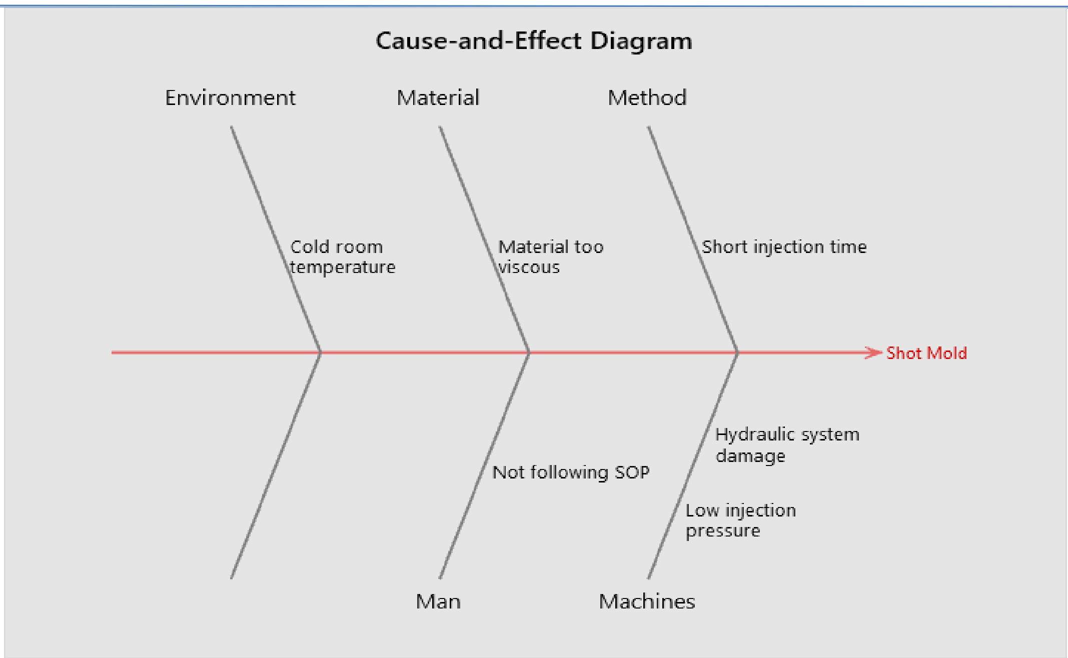
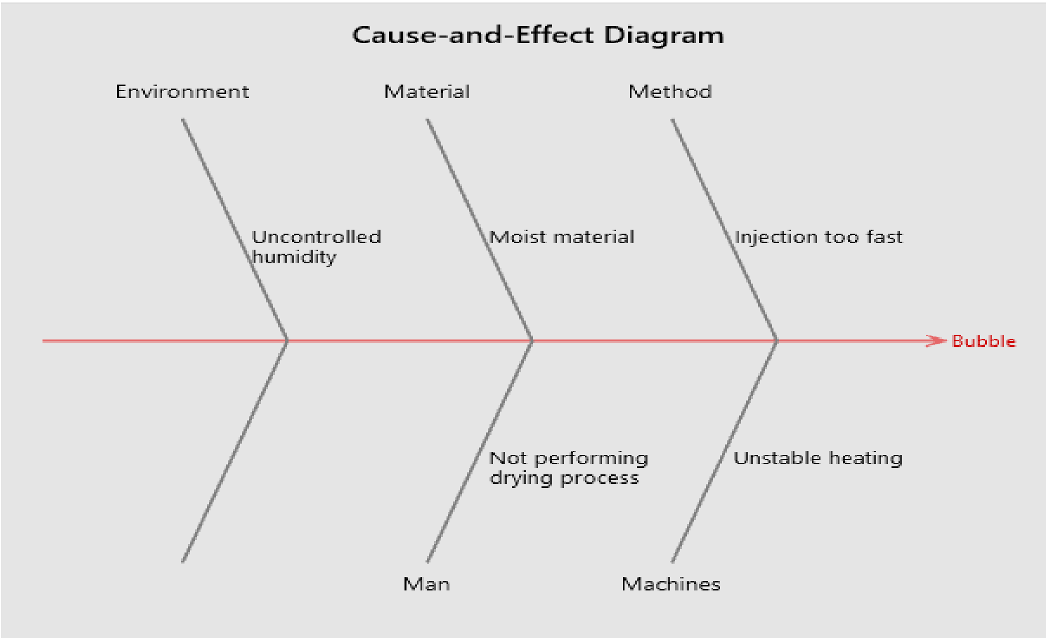


Fig. 6: Diagram Shot Mold
Source: Author's Processing Results, 2025

b. Bubble

For the consequences of bubble defects, the following is the identification of the causes in **Figure 7** Fishbone Diagram Bubble.



. **Fig. 7**: Fishbone Diagram Bubble
Source: Author's Processing Results, 2025

c. Bury Efect Mold Broken

For the consequences of the bury effect mold broken defect, the following is the identification of the cause in **Figure 8** Fishbone Diagram Bury Effect Mold Broken.

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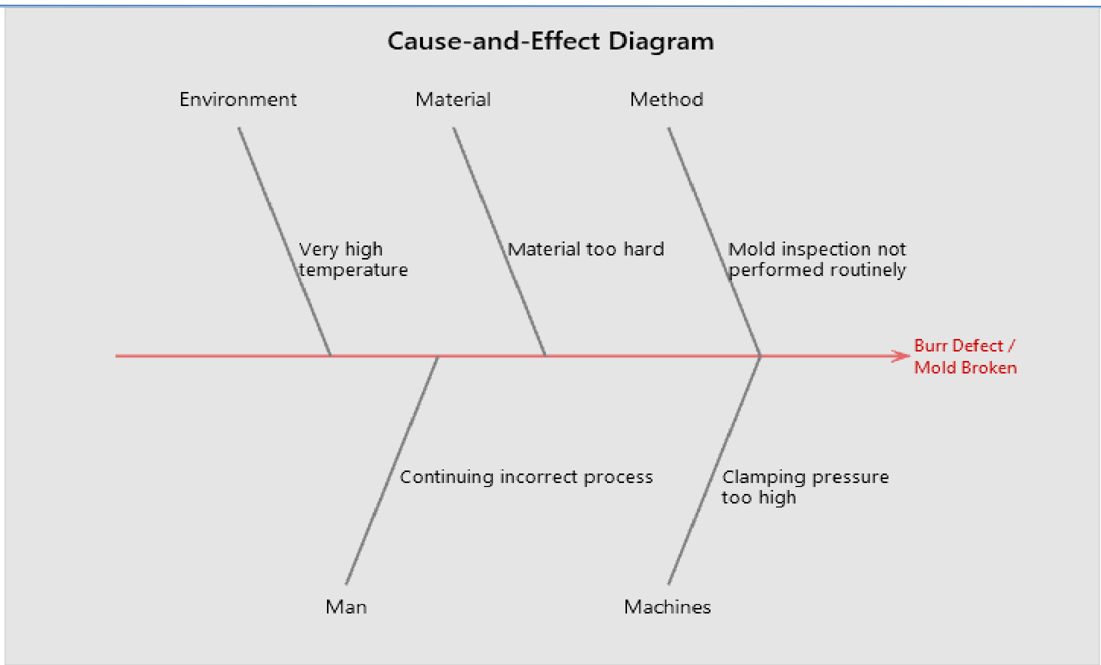
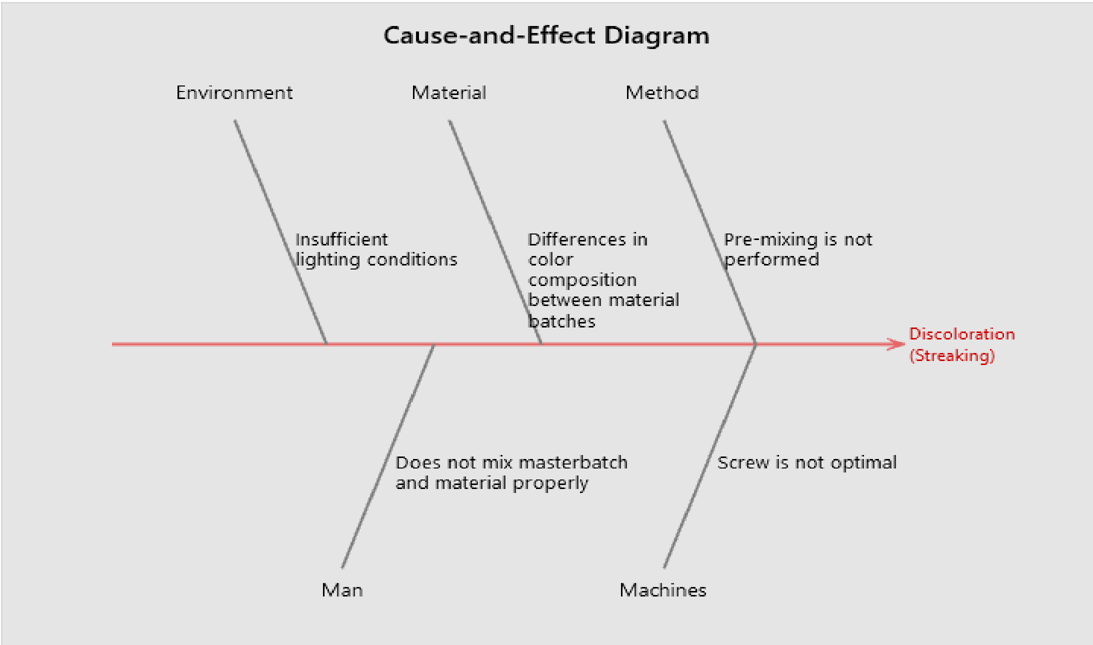


. **Fig. 8**: Fishbone Diagram Bury Efect Mold Broken
Source: Author's Processing Results, 2025

d. Discolor (Importance)

For the consequences of discolor defects (stripes), the following is the identification of the cause in **Figure 9** Fishbone Diagram Discolor (Interest).



. **Fig. 9**: Fishbone Diagram Discolor (Belang)
Source: Author's Processing Results, 2025

4. Conclusion

Conclusion The type of defect found in the instrument panel of PT. The Automotive Industry has 4 types, namely shot mold, discolor (stripe), bury effect mold broken, and bubble. The application of the Seven Tools method in identifying and analyzing the causes of defects in Instrument Panel production, with a focus on analysis using scatter diagrams, allows for the identification of clear relationships between variables that affect product quality, such as engine temperature and product defects. Based on the data that has been collected from the production process, the scatter diagram shows a pattern of correlation between the variables, which can lead to further understanding of the cause of the defect. If a significant correlation is found, e.g. higher engine temperatures are associated with increased defects, corrective actions such as temperature control adjustments or repairs to the equipment can be taken. Conversely, if there is no clear correlation, a more in-depth analysis needs to be done to explore other variables that might be contributing to the problem. Thus, the application of Seven Tools and scatter diagram analysis provides a systematic and data-driven approach to analyzing and reducing production defects in the Instrument Panel.

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