

# Quality Control Analysis of Side Member Assy RR Floor Product Using the Statistical Quality Control Method at PT XYZ

Benyamine Sulaeman\*, Fransisca Debora, Dewi Ayu Lestari, Marizka Putri Ismawaty,  
Dian Andini

Industrial Engineering Department, Universitas Singaperbangsa Karawang, Jawa Barat

\*Corresponding author: benymnsulaeman@gmail.com

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## Abstract

Quality control is a critical aspect of the manufacturing industry to ensure that every product meets the specified requirements. PT XYZ, as an automotive component manufacturer, faces the problem of a high number of defective products in the Side Member Assy RR Floor component. This study aims to analyze the quality control process using the Statistical Quality Control (SQC) method with the Seven Tools approach. The research methods include data collection through observation and documentation, followed by analysis using tools such as control charts, checksheets, histograms, Pareto diagrams, scatter diagrams, fishbone diagrams, and flowcharts. The results show that the dominant type of defect is spatter, accounting for 83.7% of total defects. Control chart analysis indicates that the process is not fully under control, as evidenced by data points falling outside the control limits. Fishbone analysis reveals that the main causes of defects originate from non-standardized work methods and insufficient operator skills. As a concrete improvement measure, Standard Operating Procedure (SOP) documents and Visual Inspection Checklist forms were developed. This study provides a tangible contribution by assisting the company in improving product quality and systematically reducing defect rates.

2025.

**Keywords:** *quality control, statistical quality control, seven tools, defective products, automotive industry*

## Abstrak

Pengendalian kualitas merupakan aspek penting dalam industri manufaktur untuk menjamin bahwa setiap produk memenuhi spesifikasi yang telah ditetapkan. PT XYZ sebagai produsen komponen otomotif menghadapi permasalahan tingginya jumlah produk cacat pada komponen Side Member Assy RR Floor. Penelitian ini bertujuan untuk menganalisis pengendalian kualitas menggunakan metode Statistical Quality Control (SQC) dengan pendekatan Seven Tools. Metode yang digunakan meliputi pengumpulan data secara observasi dan dokumentasi, serta analisis menggunakan tools seperti Peta Kendali, Checksheet, Histogram, Diagram Pareto, Scatter Diagram, Fishbone Diagram, dan Flowchart. Hasil penelitian menunjukkan bahwa jenis cacat dominan adalah spatter, dengan proporsi mencapai 83,7%. Analisis Peta Kendali menunjukkan bahwa proses belum sepenuhnya terkendali, ditunjukkan dengan adanya titik data di luar batas kendali. Dari analisis Fishbone, ditemukan bahwa penyebab utama cacat berasal dari metode kerja yang tidak sesuai standar dan kurangnya keterampilan operator. Sebagai bentuk perbaikan konkret, disusun dokumen Standard Operating Procedure (SOP) serta Formulir Checklist Inspeksi Visual. Penelitian ini memberikan kontribusi nyata dalam membantu perusahaan meningkatkan mutu produk dan menurunkan tingkat cacat secara sistematis

**Kata Kunci:** *pengendalian kualitas, statistical quality control, seven tools, produk cacat, otomotif*

## 1. Introduction

The manufacturing industry is one of the main sectors driving national economic growth and competitiveness [1]. In this industry, quality serves as a key indicator in determining a company's success in meeting customer needs and expectations. High-quality products not only ensure customer satisfaction but also reflect the effectiveness and efficiency of the company's production processes [2]. Therefore, quality control is an essential element in the manufacturing industry [3]. Quality control aims to ensure that every product produced meets the specified requirements and established quality standards [4]. In the context of the automotive industry, the implementation of quality control is particularly critical, as each component plays a vital role in the overall performance of the vehicle [5]. One approach commonly applied in quality control activities is Statistical Quality Control (SQC). This method utilizes statistical techniques to monitor and control production processes, ensuring that product quality remains within acceptable

tolerance limits [6]. The application of the SQC method is typically supported by seven quality analysis tools known as the Seven Tools, namely: check sheets, histograms, Pareto diagrams, control charts, cause-and-effect diagrams, scatter diagrams, and flowcharts [7]. These tools are considered effective in assisting the identification and resolution of problems occurring in the production process [8]. Various studies have demonstrated that the use of this method can reduce defect rates and improve process efficiency [9].

Several previous studies have examined the application of SQC in the manufacturing industry. Research conducted by Alfie Oktavia and Dene Herwanto (2021) showed that quality control of coating products can be improved through the use of control charts and operator training [10]. Meanwhile, Fitriana et al. (2020) also revealed that cracking defects and dimensional nonconformities are the main problems in the wheel rim production process [11]. However, these studies remain relatively general and have not specifically addressed structural products such as the Side Member Assy RR Floor, which are subject to stringent quality standards and serve critical structural functions. Therefore, further and more comprehensive studies are required using the SQC approach and the Seven Tools to analyze the factors causing defects and to develop concrete and applicable improvement solutions.

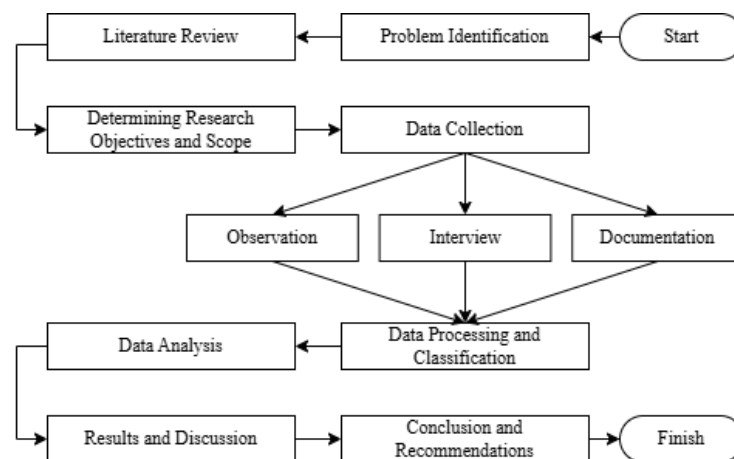
PT XYZ is an automotive component manufacturing company that produces the Side Member Assy RR Floor. During the period from July to December 2024, a relatively high defect rate was identified, with spatter being the dominant type of defect. This condition indicates a lack of process control in the production process and highlights the need for systematic and data-driven improvement efforts. This study was conducted to address this need, with the objective of analyzing the quality control process of the Side Member Assy RR Floor product at PT XYZ using the Statistical Quality Control method and the Seven Tools approach. The results of this study are expected to provide a tangible contribution to the company by reducing defect rates and improving overall product quality.

## 2. Materials and Methods

This study was conducted over the period from July to December 2024 using two categories of data: primary data and secondary data. Primary data were obtained directly through field observations of the production process and quality control activities for the Side Member Assy RR Floor product at PT XYZ, as well as through informal interviews with Quality Control staff. Meanwhile, secondary data were collected from company documents, including production reports, defect quantity records, and the quality standards applied by the company. The following is **Table 1**, which presents the classification data of the products.

**Table 1.** Production and Defect Data per Month

Month	Total Production	Number of Defective Product	Defect Percentage
Jul	3843	327	8,5%
Agu	1104	451	40,9%
Sep	4935	2839	57,5%
Okt	5607	4032	71,9%
Nov	3692	444	12,0%
Des	2760	649	23,5%
Total	21941	8742	39,8%
Average	3656,8	1447	35,7%



**Figure 1.** Research Flow

### 3. Results and Discussion

Based on the collected defect data for the Side Member Assy RR Floor, defects were classified into four types: scratch, spatter, touching, and unsmooth. To address issues related to defective products, various quality control tools were applied, including check sheets, flowcharts, histograms, Pareto diagrams, scatter diagrams, and cause-and-effect (fishbone) diagrams.

#### a. Checksheet

The initial stage of quality control using the Statistical Quality Control (SQC) approach is carried out by preparing a checksheet [12]. The data used in this study consist of production output data of the Side Member Assy RR Floor from July to December 2024.

**Table 2.** Checksheet Side Member Assy RR Floor

Month	Total Production (Unit)	Number of Defective Product (Unit)	Defect Categories			
			Spatter	Unsmooth	Scratch	Touching
Jul	3843	327	0	311	16	0
Agu	1104	451	420	31	0	0
Sep	4935	2839	2828	10	1	0
Okt	5607	4032	4008	8	0	16
Nov	3692	444	30	0	0	414
Des	2760	649	35	0	0	614
Total	21941	8742	7321	360	17	1044

Based on the table above, there are four types of defects in the Side Member Assy RR Floor product, namely spatter, unsmooth, scratch, and touching. During the period from July to December, total production reached 21,941 units, with 8,742 defective units identified. Of these, 7,321 units experienced spatter defects, 360 units unsmooth defects, 17 units scratch defects, and 1,044 units touching defects. This checksheet summary was used as the basis for calculating defect proportions and determining quality control limits.

#### b. Control Chart

Product quality control was carried out using a proportion control chart (P-Chart). The P-Chart is one of the tools in Statistical Quality Control (SQC) used to monitor the proportion of defective units in a production process with varying sample sizes [13]. This tool is appropriate for cases in which the analyzed data are attribute data, particularly defective (defectives) data. To statistically demonstrate the quality control process, a manual calculation of the defect proportion and control limits for the July sample is presented below.

P-Chart Formula:

$$\bar{p} = \frac{\sum d}{\sum n}$$

$$\sigma_p = \sqrt{\frac{\bar{p}(1 - \bar{p})}{n}}$$

$$UCL = \bar{p} + 3\sigma_p$$

$$LCL = \bar{p} - 3\sigma_p$$

Description:

$d$  : Number of defective unit in one month

$n$  : Number of sample units (production quantity)

$\bar{p}$  : Overall average defect proportion

$\sigma_p$  : Standard deviation of the proportion for each month

$UCL$  : Upper Control Limit

$LCL$  : Lower Control Limit

Manual Calculation for July (Sample)

- Average Proportion

$$\bar{p} = \frac{\sum d}{\sum n} = \frac{8.742}{21.941} = 0,3984$$

- Standard Deviation

$$\sigma_p = \sqrt{\frac{\bar{p}(1 - \bar{p})}{n}} = \sqrt{\frac{0,3984(1 - 0,3984)}{3.843}} = 0,0079$$

- Controls Limit

$$UCL = \bar{p} + 3\sigma_p = 0,3984 + 3(0,0079) = 0,4221$$

$$LCL = \bar{p} - 3\sigma_p = 0,3984 - 3(0,0079) = 0,3747$$

Based on the calculation of the defect proportion (p), the  $\bar{p}$  value of 0.3984 was used as the center line (CL). The upper control limit (UCL) and lower control limit (LCL) were then calculated using the standard P-chart formula, taking into account the monthly production quantities as  $n$ . The following table presents the P-Chart recap for the period from July to December 2024.

Table 3. P-Chart Recapitulation

Month	Total Production (unit)	Number of Defective Product (Unit)	Defect Proportion (p)	CL $\bar{p}$	UCL	LCL
Jul	3843	327	0,0851	0,3984	0,4221	0,3747
Agu	1104	451	0,4085	0,3984	0,4426	0,3542
Sep	4935	2839	0,5753	0,3984	0,4193	0,3775
Okt	5607	4032	0,7191	0,3984	0,4180	0,3788
Nov	3692	444	0,1203	0,3984	0,4226	0,3743
Des	2760	649	0,2351	0,3984	0,4264	0,3705

After calculating the data in the P-chart table, a P-chart graph was obtained and is presented below. This graph illustrates the proportion of defective units in each sample, which helps monitor the stability of the production process and identify deviations or lack of control within the process.

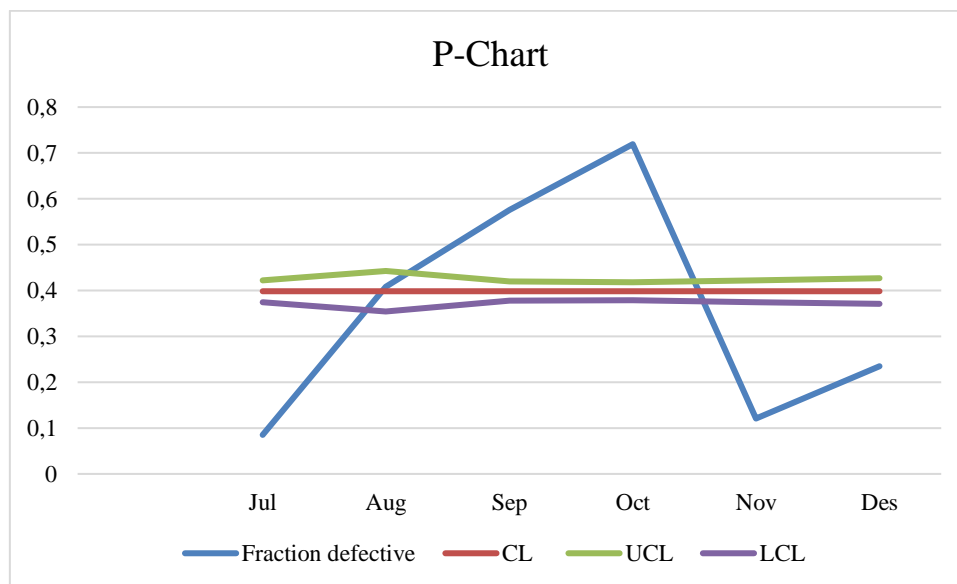


Figure 2. The proportion of defective units in each sample

Based on the calculation results, the average defect proportion ( $\bar{p}$ ) was 0.3984. The upper control limit (UCL) and lower control limit (LCL) were calculated individually based on the production quantity for each month. Several months showed defect proportions exceeding the UCL, such as September (0.5753) and October (0.7191). This indicates that the production process during these periods was statistically out of control, suggesting the presence of significant process deviations that require further evaluation.

Conversely, July, November, and December exhibited defect proportions below the LCL or considerably lower than the CL, which also indicates process anomalies that need to be analyzed. Overall, the chart shows that the production process is not yet stable and requires corrective actions to reduce variability and maintain consistent product quality.

c. Scatter Diagram

The scatter diagram was used in this study to examine the relationship between production volume and the number of defective products each month. In the scatter diagram, the horizontal axis (X) represents the number of units produced, while the vertical axis (Y) represents the number of defective units. Each point on the graph represents a data pair of production quantity and defect quantity for a specific month, from July to December.

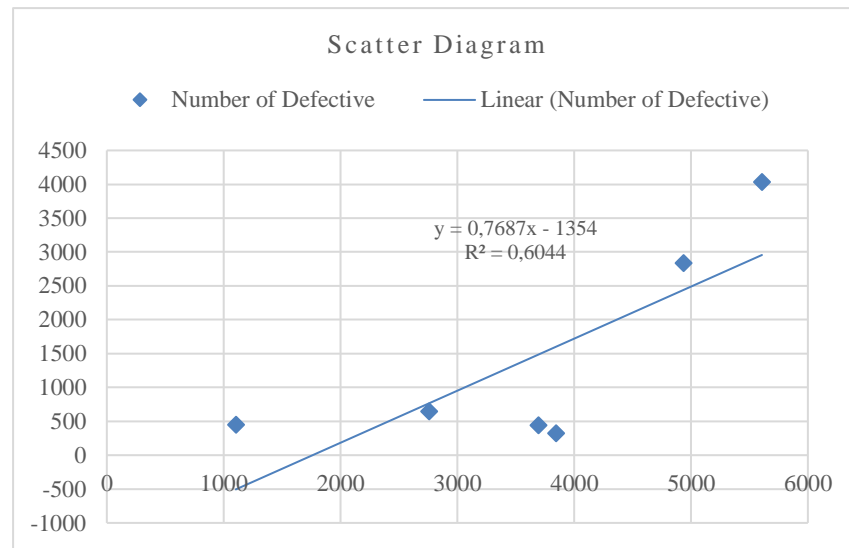


Figure 3. Regression Analysis of Monthly Product Defects

The resulting regression line equation is  $y = 0.7687x - 1354$ , with a coefficient of determination  $R^2 = 0.6044$ . This equation indicates that for every one-unit increase in production volume, the number of defective units tends to increase by 0.7687 units. The  $R^2$  value of 0.6044 shows that approximately 60.44% of the variation in the number of defects can be explained by production volume. The remaining 39.56% is influenced by other factors not captured in this model, such as raw material quality, operator skills, machine effectiveness, or the quality control system applied.

d. Histogram

A histogram, or bar chart, is a tool used to illustrate the distribution or progression of a studied variable over a specific time period based on the collected data [14]. The histogram is presented in the form of bars grouped according to each observed category, as shown in Figure 4.

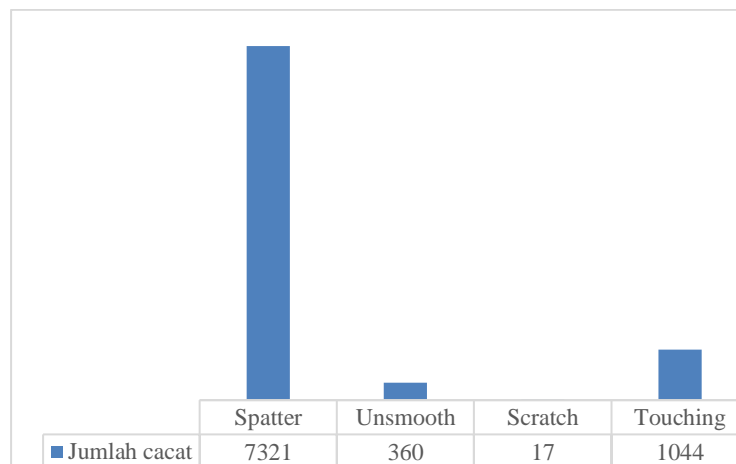


Figure 4. Frequency of Occurrence for Each Defect Type

The histogram above illustrates the distribution of product defect types. It can be observed that spatter defects are the most dominant, with a total exceeding 7,321 units, far surpassing the other defect types. Touching ranks second with approximately 1,044 defective units, followed by unsmooth defects totaling 360 units, while scratch defects have a very low frequency of only 17 units.

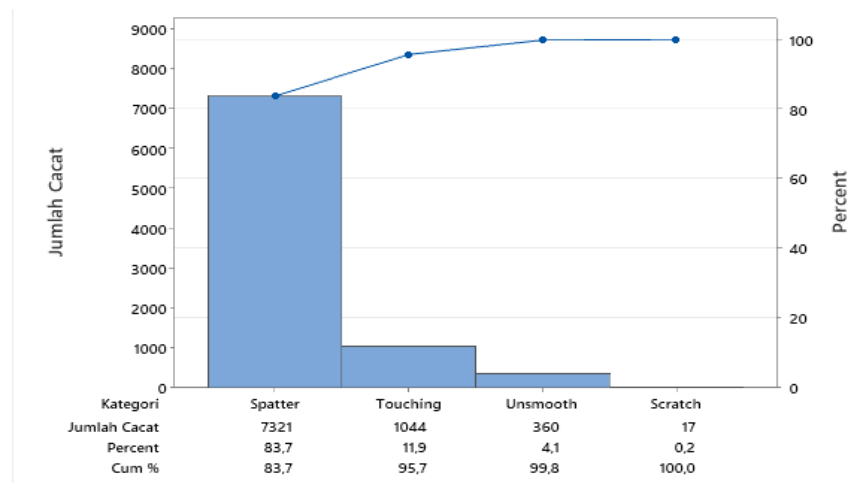
e. Pareto

The Pareto diagram presents important information regarding the most dominant types of defects in a product by arranging defect categories from the most frequent to the least frequent. This diagram helps identify key priorities for quality improvement in order to enhance production efficiency and significantly reduce defect rates [15].

**Table 4.** Data Summary of Defect Occurrences

Defect Categories	Total Defect	Defect Percentage
Spatter	7321	83,7%
Unsmooth	360	4,1%
Scratch	17	0,2%
Touching	1044	11,9%
Total	8742	100%

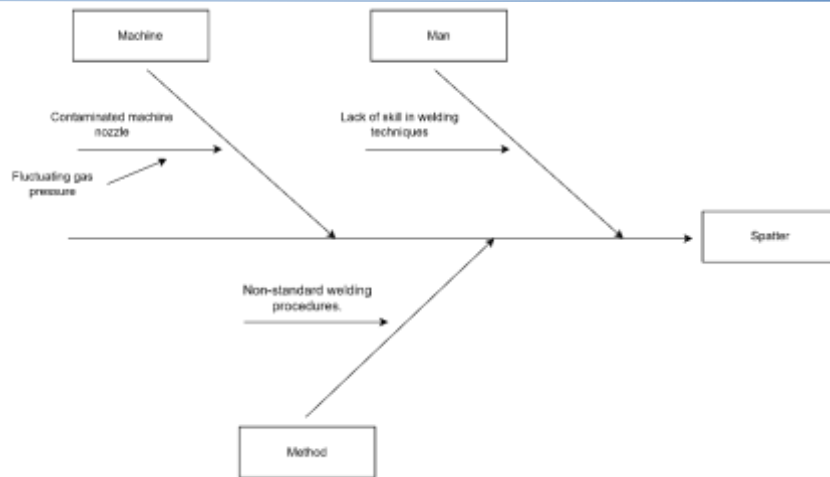
Based on the data presented in the table above, a Pareto diagram was constructed to compare the number of defects in each category of the Side Member Assy RR Floor product. The diagram below illustrates the distribution of defect types during the period from July to December 2024 at PT XYZ, as shown in **Figure 5**.



**Figure 5.** Pareto Analysis for Identifying Dominant Defects

f. Fishbone Diagram

After identifying the types of defects occurring in the Side Member RR Floor product, it was found that spatter defects have the highest occurrence. Therefore, immediate corrective actions are required to reduce the likelihood of similar defects. These actions must be aligned with the underlying problems, making it essential to first identify the factors causing the defects. One tool that can be used for this purpose is the fishbone diagram [16]. Accordingly, the identification of causes and proposed improvement actions using a fishbone diagram was developed for this defect category, as shown in Figure 6.



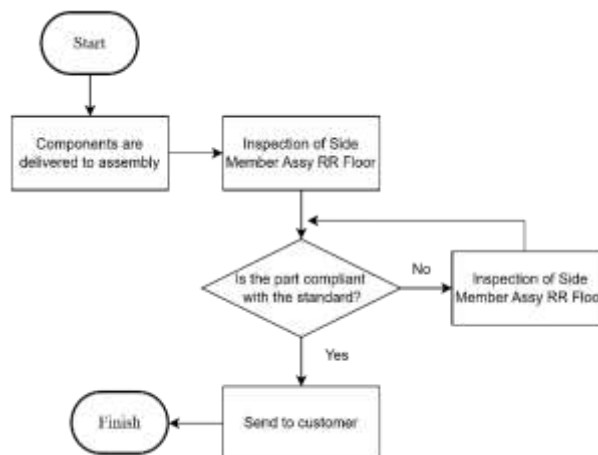
**Figure 6.** Fishbone Diagram of Spatter Defects

The factors causing spatter defects can be observed in the figure above. Based on the results of the analysis and interviews conducted, it was found that the potential factors contributing to the occurrence of spatter include man (human), machine, and method factors. Among these three factors, the method factor has a greater influence on the occurrence of spatter compared to the others, as it is directly related to the setting of welding process parameters and the work procedures applied.

**Table 5.** Analysis of Factors Contributing to Spatter Defects

Factor	Causes	Proposed Improvement
Man	Operators lack sufficient skills in welding techniques.	Operator retraining.
Machine	Dirty machine nozzles and unstable gas pressure.	Regular cleaning schedule.
Method	Non-standard welding procedures.	Updated and supervised welding SOP.

g. Flowchart



**Figure 7.** Flowchart of Product Inspection Process

The flowchart above illustrates the quality inspection and handling process for the Side Member Assy RR Floor components before delivery to customers. The process begins with the components being sent to the assembly department, followed by a quality inspection stage. If any nonconformities with the standards are detected during inspection, problem identification and corrective actions are carried out. After corrections are made, the parts are rechecked to ensure compliance with the established standards. Once the parts meet the standards, the next step is to deliver the products to the

customers. The process concludes with a final stage marking the completion of the workflow. This flowchart reflects a systematic quality control system focused on meeting quality standards before the products reach the customers, ensuring product reliability and customer satisfaction.

#### 4. Conclusion

Based on the results of the analysis conducted using the Seven Tools approach within the Statistical Quality Control (SQC) method, it can be concluded that the quality control process for the Side Member Assy RR Floor component at PT XYZ is not yet optimal. This is evidenced by the presence of defective products exceeding the control limits on the P control chart. Further analysis using histograms and Pareto diagrams identified spatter as the most dominant defect type (83.7%), followed by touching (11.9%), unsmooth (4.1%), and scratch (0.2%).

The main causes of defects, based on the fishbone diagram analysis, were classified into three primary categories: human factors (insufficient operator skills in the welding process), machine factors (dirty nozzles and unstable gas pressure), and method factors (the absence of standardized welding procedures). The inspection and handling process of components prior to delivery to customers was systematically illustrated through the developed flowchart.

As a follow-up, several improvement recommendations were formulated with a focus on practical efforts to reduce the number of defective products. These recommendations include the development of new Standard Operating Procedures (SOPs) for the welding process, the implementation of visual inspection and machine current checklist forms, as well as the execution of operator training, daily briefings, and more intensive process supervision. All recommendations are supported by accompanying documents as part of the company's commitment to continuous product quality improvement.

#### 5. Acknowledgment

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