Quality Control Issues and Improvement Opportunities for Automobile Manufacturing Company in Indonesia

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Abstract
An effective quality control system is crucial for maintaining customer satisfaction and business success. However, quality control is broad and complex in nature, and there is no single system that fits all manufacturing settings. Hence, it is crucial for manufacturers to explore a quality control system that best suits their specific manufacturing environment. As such, this study aims to identify key quality control steps (RO1), explore quality control problems (RO2), and discover quality improvement opportunities (RO3) for an automobile manufacturing company in Indonesia. The research is qualitative in nature and involved semi-structured interviews with nine quality staff members from the company. Feedback from the interviewees was analysed using Kendall's coefficient of concordance to address RO1, and content analysis was used for RO2 and RO3. The results of the Kendall analysis revealed that establishing quality benchmarks is the most important step in quality control. The content analysis suggested that inconsistencies in quality control practices and procedure are the main quality problem faced by the company. Additionally, the interviewees suggested that quality improvement efforts should focus on the application of digital technology. This study provides valuable insights into the multifaceted nature of quality control in the automotive industry, underscoring the importance of continuous improvement and technological integration in maintaining a competitive edge and ensuring customer satisfaction.
Keywords: Quality Control, Improvement Opportunities, Kendall's Test, Automotive Industry, Quality Management

Introduction
In the current era of globalization and the industrial revolution, companies are required to continuously adapt to evolving conditions. This reflects how environmental developments both inspire and pressure businesses to consistently deliver their best. Under such circumstances, companies must maintain or improve product quality to ensure their products remain viable (Bajic et al., 2023). According to Farahani et al. (2019), product quality is a

critical aspect that companies must prioritize, especially those aiming to sustain their business in the face of intense competition and to foster growth. However, this is not a simple task. Companies must first establish a clear understanding of what constitutes good product quality, what is considered excellent, how to achieve it, how to maintain it, and the consequences of failing to do so. Although it may seem challenging and time-consuming, maintaining high product or service quality can bring substantial benefits to operations and business performance.

Bousdekis et al. (2023) define quality as a manufacturer's effort to achieve customer satisfaction by meeting customer needs, expectations, and aspirations through measurable actions reflected in the results achieved. These actions encompass several dimensions of quality, including performance, reliability, durability, serviceability (ease of repair), aesthetics, features (product characteristics), perceived quality (such as brand loyalty derived from a strong reputation), and conformance to standards (the extent to which a product meets established specifications) (Sabella et al., 2014). An effective quality control system is crucial for sustaining customer satisfaction and ensuring business success. However, quality control is inherently broad and complex, and no single system can be universally applied to all manufacturing environments. Therefore, it is essential for manufacturers to identify a quality system that best suits their specific operational context. Accordingly, this study aims to address the following research objectives:

RO1: To identify the importance ranking of quality control steps in an automobile manufacturing company in Indonesia.
RO2: To explore the quality control problems faced by the automobile manufacturing company in Indonesia.
RO3: To identify quality control improvement opportunities in the automobile manufacturing company in Indonesia.

Quality Control Steps
Quality control was first introduced by Eli Whitney in the early 19th century. He implemented quality control by inspecting goods before delivery, separating defective items from non-defective ones based on their appearance and characteristics. This approach aimed to ensure customer satisfaction by providing products of acceptable quality and is known today as traditional quality control.

Quality is defined as conformance to requirements, that is adherence to established standards. A product is considered to have quality if it meets the quality standards set by the company or outlined in standard operating procedures (SOPs). These standards typically cover raw materials, production processes, and finished products (Szymanska, 2020). Quality is also viewed as a dynamic condition involving products, human resources, processes, tasks, and the environment, all of which must align with customer expectations (Abbas and Kumari, 2023;). According to Alofan et al., (2020), quality control is a managerial activity involving a series of steps aimed at maintaining and ensuring that the quality of a company's products and services remains consistent with planned objectives.

Empirical research generally reveals that there are six main steps involved in controlling product and process quality, as illustrated in Figure 1. Step 1 involves establishing the targeted

product and process quality specifications. This is followed by Step 2, which focuses on assessing the actual product and process quality. Next, Step 3 involves analysing the differences or variances between the targeted and actual quality. Step 4 consists of establishing statistical acceptance limits for the variances identified in Step 3. Step 5 outlines the corrective actions to be taken if the variances exceed the statistical acceptance limits. Finally, in Step 6, the corrective actions that successfully resolve the variances are documented and integrated as part of the continuous quality improvement process.

Figure 1 Quality Control Steps (Adopted from MBA Skool, 2021)

Table 1 summarizes the common quality control steps identified from empirical studies related to quality control practices in Indonesia's manufacturing sector. Haryadi (2018) conducted a study at PT Toyota Boshoku Indonesia, a company in the automotive industry specializing in car seat production. The study focused on the cutting-sewing production area and was limited to analysing defect data from the cutting process. The purpose of the study was to understand the largest types of defects produced by the cutting machines, identify the main factors causing these defects, and determine ways to ensure that the products sent to the next process were of high quality.

Table 1
Empirical Studies on Quality Control Steps

Quality Control Steps	Haryadi (2018)	Jumriani (2018)	Adita (2019)	Fakhri (2023)	Bakhtiar (2013)
Establish quality benchmark	✓	✓	✓	✓	
Check product/service quality	✓	✓	✓	✓	
Analyze variance between target & actual		✓			✓
Check variances statistical limit		✓		✓	✓
Take corrective action	✓		✓	✓	
Establish steps to improve quality	ü	✓		✓	✓

Jumriani (2018) studied the implementation of quality control in sugar production at PTP. NUSANTARA XIV (PERSERO) Takalar Sugar Factory. The research, carried out using qualitative descriptive methods, aimed to understand the process of converting raw material into crystal grains with the aid of a quality control system and improve the production quality to maintain

competitiveness. Adita (2019) focused their research on quality control analysis at PT. Pacific Eastern Coconut Utama in Pangandaran. The study aimed to understand the implementation of quality control in the production of coconut milk, its quality, and how quality control enhances the product quality. The study was descriptive qualitative and used data from interviews, observations, and documentations

Fakhri et al. (2023) conducted a study on the quality control of cooking oil packaging products in Indonesia. The objective of the study was to determine the level of product damage and evaluate the effectiveness of the company's quality control processes using statistical tools. The analysis employed various quality control instruments, including check sheets, histograms, p-charts, Pareto charts, and cause-and-effect diagrams. Bakhtiar et al. (2013) focused on quality control in the production of nutmeg syrup at UD.Mestika, located in Tapaktuan, Aceh Selatan. The study aimed to control the quality of finished nutmeg syrup products and identify causes of quality deviations using statistical tools, including the seven quality control tools (check sheet, histogram, Pareto diagram, cause-effect, scatter diagram, control map, and stratification).

An interesting observation from the review of empirical findings is that most prior studies of quality control steps within Indonesia manufacturing sectors tend to focus on selected steps rather than addressing all six commonly recognized quality control steps. This suggests that researchers place or perceive different levels of importance on each of the six steps. Consequently, a practical knowledge gap appears to exist in the context of quality control within the automobile manufacturing industry, particularly regarding how each quality control step should be prioritized. This research closes the practical knowledge gap by assessing the importance ranking of quality control steps in an automobile manufacturing company in Indonesia. Additionally, the research also explores the quality control problems and improvement opportunities for an automobile manufacturing company in Indonesia.

Research Methodology
This qualitative study involved nine experts from an automobile manufacturing company in Indonesia. The experts held a wide range of positions, including section heads, managers, and quality control leaders (refer to Table 2), thus offering valuable insights from both strategic management and practical operational perspectives.

Table 2
Profile of interviewees

No	Designation	Current Position	Years of Experience in Quality Control
1	RA	Section Manager	14
2	RB	Manufacturing Quality Engineer	5
3	RC	Engineering Supervisor	12
4	RD	Quality Control Leader	6
5	RE	Quality Control Leader	7
6	RF	Quality Engineer	6
7	RG	Quality Inspector	4
8	RH	Manufacturing Quality Engineer	11
9	RI	Section Head	11

To assess the importance ranking of quality control steps in the company (RO1), the experts were asked to rank the six steps based on their perceived importance—ranging from rank 1 (most important) to rank 6 (least important). The Kendall coefficient test was used to analyze the rankings, as it measures the degree of agreement among experts. A p-value (Asymp. Sig.) of less than 0.05 indicates that the experts' rankings are statistically consistent. The Kendall coefficient of concordance (W) ranges from 0 to 1, where a value of 0 represents no agreement among respondents, while a value of 1 represents full agreement.

Semi-structured interviews were conducted to gather expert opinions on quality control problems and improvement opportunities in the company (RO2 and RO3). The interview protocol began with an introduction outlining the main objectives of the interview to establish the context for the discussion. It also included essential procedures for obtaining participant consent, emphasizing the confidentiality of responses, and affirming the participant's right to withdraw at any time. These steps ensured that participants were well-informed and voluntarily engaged in the interview process. Thematic analysis was employed to identify recurring patterns and themes in the interview data related to quality control problems and potential improvement opportunities. This method allowed the researcher to develop categories and themes inductively, without the need for predefined coding rules or procedures.

Addressing RO1: The Important Ranking of Quality Control Steps
To address Research Objective 1 (RO1), which aims to identify the importance ranking of quality control steps as perceived by nine experts in an automobile manufacturing company in Indonesia, the proposed rankings are summarized in Table 3. In this table, Rank 1 represents the most important step, while Rank 6 represents the least important.

Table 3
Ranking of Importance by Experts

Quality Control Steps	RA	RB	RC	RD	RE	RF	RG	RH	RI	Average
Establish quality benchmarks	1	2	1	3	3	1	2	1	1	1
Check product/service quality	2	3	2	1	1	3	1	2	2	2
Analyze variance between target & actual	6	4	5	4	5	6	6	5	6	6
Check variances statistical limit	5	5	6	5	4	5	5	6	5	5
Take corrective action	4	6	4	6	6	4	4	4	4	4
Establish steps to quality improve	3	1	3	2	2	2	3	3	3	3

The rankings proposed by the experts were subsequently analyzed using Kendall's coefficient of concordance. The results of this analysis are presented in Figure 2. As shown, the Kendall's coefficient of concordance (W) is 0.794, and the p-value is < 0.01. Since the p-value is less than 0.05, the result indicates that the rankings provided by the nine experts are statistically consistent.

Test Statistics

N	9
Kendall's W[a]	.794
Chi-Square	35.730
df	5
Asymp. Sig.	<,001

Figure 2 Kendall's Coefficient of Concordance Test Result

Based on the average ranking scores, "Establish quality benchmarks", that is, establishing the targeted product and process quality specifications, was commonly agreed upon by the experts as the most important quality control step. This finding supports the work of Maiga and Jacobs (2006), who emphasized benchmarking as a key strategy for quality improvement and achieving better performance. Horváthová et al. (2021) further noted that establishing quality benchmarks involves defining service quality standards, which are essential for differentiating a business from its competitors and gaining a competitive advantage.

The step of "Check product/service quality", or assessing the actual product and process quality, was ranked as the second most important QC step. This aligns with traditional quality control principles, which emphasize the need for regular inspections and assessments to ensure that products or services meet defined standards. Experts ranked "Establish steps to quality improve", or continuous quality improvement processes, as the third most important step. This was followed by "Take corrective action" and "Check variance statistical limit", which were ranked fourth and fifth, respectively.

Meanwhile, "Analyse variance between target & actual" was viewed by experts as the least important quality control step. To better understand this result, the researcher discussed the ranking with the experts and inquired about the rationale behind this view. The experts generally agreed that comparing actual performance to target specifications does not necessarily provide clear insight into whether quality improvements are needed. Instead, they believed it is more meaningful to compare actual performance against statistically established limits to identify potential issues.

Additionally, "Check variance statistical limit" was ranked as the second least important step because, in the company studied, statistical limits are automatically generated by Statistical Process Control (SPC) software once quality data is uploaded. This automation may contribute to the perception that the step requires less active input or decision-making.

Addressing RO2: Quality Control Problems
To address Research Objective 2 (RO2), which aims to explore the quality control problems faced by the automobile manufacturing company, thematic analysis was applied to identify recurring themes from the semi-structured interview data. Table 4 summarizes the top three common themes identified through this analysis, along with the frequency with which each theme was mentioned during the interviews.

Table 4
Thematic Analysis Result for RO2

Themes	Frequency
Inconsistency on quality practices	14
Lack of procedure or standards	7
People related problem	8

According to Table 4, the nine experts viewed inconsistency in quality control practices as the primary problem faced by the company, followed by the lack of clear procedures or standards for quality control processes, and people-related issues. During the interviews, participants RA, RE, and RF shared their thoughts on the root causes behind many of the quality control challenges:

"*In my opinion, inconsistency in following work standards is one of the root causes of most quality control. Lack of skills is also another factor that can determine the quality control of our products. This lack of expertise is usually caused by internal and external factors. Internal factors could be a lack of training from the company, external factors could be a lack of experience or knowledge from the worker regarding quality.*"

<div align="right">Interviewee RA</div>

"*In my experience, the problems that usually occur are usually caused by a lack of supervision or control. An ineffective supervision system or lack of monitoring of the production process can allow quality problems to occur. Moreover, the quality standards that must be met are not strictly monitored. This could include safety standards, fuel efficiency, or other technical specifications that vehicle manufacturers must follow.*"

<div align="right">Interviewee RE</div>

"*Human error. Sometimes, human error such as lack of training, negligence, or fatigue can be the cause of problems in quality control.*"

<div align="right">Interviewee RF</div>

Both RA and RF emphasized that lack of skills is a root cause of quality control problems. Meanwhile, RE attributed the issues primarily to lack of effective supervision, which can lead to several quality-related problems, particularly concerning compliance with safety standards and technical specifications.

"*A common challenge that we usually face is inconsistency in implementing work standards. I apply intensive training and evaluation accompanied by high levels of discipline and moral control to be able to implement work standards in the terms of quality.*"

<div align="right">Interviewee RA</div>

This statement reinforces RA's earlier point and suggests that inconsistencies in applying work standards can be mitigated through structured training, evaluation, and strong organizational discipline.

Addressing RO3: Quality Control Improvement Opportunities

To address Research Objective 3 (RO3), which aims to explore the quality control improvement opportunities proposed by experts in the automobile manufacturing company, thematic analysis was applied to identify recurring themes in the semi-structured interview data related to this topic. Table 5 summarizes the top three common themes identified through the analysis, along with the frequency each theme was mentioned during the interviews.

Table 5
Thematic Analysis Result for RO3

Themes	Frequency
Digital Technology	9
Procedures and Regulations	8
Training	3

As shown in Table 5, the nine experts viewed the adoption and implementation of digital technology in quality control systems and processes as the most critical improvement opportunity for the company under study. In alignment with the issues identified in RO2, namely the lack of procedures or standards and people-related problems, the experts also emphasized the need for improvement in quality control procedures and regulations, as well as the enhancement of training related to quality control. Below are selected insights from the expert interviews:

"Quality big data analysis. Based on my understanding, this procedure uses advanced analytics tools and algorithms, for example machine learning and predictive analytics, to handle complex information."

Interviewee RG

"As technology develops, improving quality control with the use of digital technology opens up many interesting opportunities for digitalization. Some of the technologies that we anticipate are digital quality inspection. Digital quality inspection itself is an approach that integrates digital technology in the quality control process to increase efficiency, accuracy and responsiveness."

Interviewee RH

"From observations I have made while working in the automotive industry, there are actually many quality control improvement opportunities that I think can be implemented. But again, to implement it you have to go through a fairly complex process. Starting from approval from top management at the factory, to approval from the center (HQ). So, for now I think the government's drafting of stricter regulations plays an important role in encouraging manufacturers to comply with even higher standards."

Interviewee RI

These responses illustrate a broad range of perspectives on how quality control can be improved. RG emphasized the value of big data analytics, particularly through machine

learning and predictive algorithms, to enhance quality assurance by managing complex information. RH highlighted the role of digital quality inspection, which integrates technology to improve efficiency and accuracy in the inspection process. RI pointed out that while improvement opportunities exist, their implementation is often challenged by the need for multi-level approvals, and emphasized the importance of regulatory pressure in driving quality advancements.

"Digitalization in the automobile sector is taking advantage of information technology to enhance the efficiency and precision of vehicle inspections. This includes the implementation of advanced diagnostic technologies capable of quickly and precisely identifying issues with vehicles."

<div align="right">Interviewee RH</div>

This additional insight from RH reinforces the role of digitalization in improving quality control practices. Specifically, RH emphasized how advanced diagnostic tools can facilitate quicker and more precise identification of issues, thereby streamlining the inspection process.

Discussions and Conclusion

The findings of Research Objective 1 (RO1) indicate that within the context of the automobile manufacturing company, it is crucial to define targeted product and process specifications; establish a system for continuous data collection on quality performance; and implement a structured quality improvement process. This quality improvement process should include clearly defined statistical variance limits and a documented corrective action procedure to ensure both consistent quality control and ongoing performance enhancement.

The thematic analysis of quality issues under Research Objective 2 (RO2) revealed three prominent themes, "Inconsistency in quality practices", "Lack of procedures or standards", "People-related problems". The first two themes highlight that inconsistencies in applying quality control procedures and the absence of standardized protocols can lead to product quality variability, which in turn impacts customer satisfaction and sales performance. The issue of inconsistency reflects the challenge of maintaining uniform quality control practices across different stages of the manufacturing process, underscoring a critical area for improvement. The third theme, people-related problems, encompasses issues such as insufficient skills, lack of training, and human error, these are challenges that commonly observed in manufacturing environments. The findings further revealed that effective workforce management, including skill development, training, and employee engagement, plays a vital role in ensuring consistent product quality.

The findings from Research Objective 3 (RO3) suggest that digital technology presents a significant opportunity for improving quality control. The most frequently cited theme was the adoption of digital technologies, including advanced diagnostics, automation, and data analytics. These technologies not only enhance the efficiency and accuracy of quality control processes but also address key challenges identified in RO2, such as inconsistency in quality practices. This aligns with Arromba et al. (2020), who noted that digital transformation of routine operations in quality management reduces time costs and the probability of human error. Additionally, improvements in quality control procedures and regulations were identified as the second most important improvement area by experts. Abbas and Kumari

(2023), emphasized, adherence to established production and quality control procedures ensures consistent product quality. Strengthening these procedures minimizes process deviations and product defects, thereby reinforcing the importance of well-defined standards and protocols.

In summary, the research findings provide valuable insights and practical implications for quality control in Indonesian automobile manufacturing companies. Emphasizing the establishment of clear quality benchmarks and standardized procedures can help companies address inconsistencies in product quality. Moreover, the integration of digital technology into quality control systems presents a strategic opportunity to improve operational efficiency, reduce errors, and enhance the consistency of manufacturing outcomes. By implementing these targeted improvements based on the research findings, companies can significantly improve the reliability and competitiveness of their products.

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