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Digitalization System to Improve Efficiency & Quality Through the Selective QC 7 Tools Method in the Component Automotive Industry

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ABSTRACT

The automotive component industry faces significant challenges in improving operational efficiency and production quality, particularly due to reliance on manual processes. A key issue identified is the company's Overall Equipment Effectiveness (OEE) performance, which has not met the established target, with an average achievement of only 72%, indicating considerable process inefficiencies and productivity losses. External pressures such as global market dynamics, economic uncertainty, and increasing Regional Minimum Wage (*UMP*) rates have further exacerbated the need for digital transformation to enhance operational efficiency and organizational competitiveness. This study aims to design a digitalization system to address operational inefficiencies and low production quality in the automotive component industry, focusing on improving OEE performance, reducing operational costs, and supporting data-driven decision-making. This research proposes an integrated digitalization system developed through the combination of the selective QC 7 Tools and Design Thinking approaches, with the selective QC 7 Tools applied to systematically identify and analyze the root causes of operational inefficiencies. The implementation resulted in significant improvements, including the complete elimination of 195 minutes per shift of non-value-added activities, the reduction of reporting lead time from 2–3 days to near real-time (0.5 days for analysis), and a 10% increase in OEE performance. The system also enabled the reallocation of 13 administrative personnel to more value-added roles, reduced operational costs, and minimized paper waste and CO_2 emissions. This study confirms that the selective QC 7 Tools prove effective in supporting digital transformation, and that data-driven digitalization can significantly improve competitiveness and business sustainability.

INTRODUCTION

In this era of globalization, from year to year the competition of the two-wheeled automotive industry to seize the market feels so tight from various types of business competition (Kumbhare, 2025; Näsman & Ballor, 2024; Rahaditya, 2022). The global automotive industry is currently undergoing a major transformation as a result of technological developments, changes in environmental policies, and shifting consumer preferences. One of the sectors that has experienced significant development is the motorcycle market, which is the main mode of transportation in various developing countries, especially in the Southeast Asian region (Guillen et al., 2026; Kim et al., 2025; Marija et al., 2022; Ong et al., 2024;

Vongpraseuth et al., 2022). Motorcycles have advantages in terms of cost efficiency, mobility flexibility, and ease of operation compared to four-wheeled vehicles, so their demand continues to increase along with population growth and urbanization.

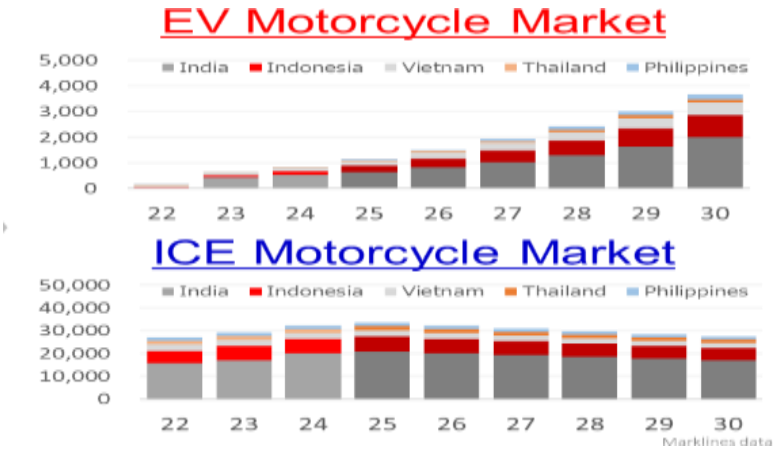

Figure 1 Global Motorcycle Market, 2022-2030

(Source: Yano Research Institute, Marklines data, 2024)

Based on the economic forecast scenario data shown in Figure 1.1, the total global motorcycle market is still dominated by Internal Combustion Engine (ICE)-based vehicles, but electric vehicles or Electric Vehicles (EVs) show a significant growth trend. In 2022, the proportion of electric vehicles is only around 13% of the total motorcycle market, but is projected to increase to 41% by 2030. In contrast, although ICE vehicles still dominate market volume, their proportion is gradually decreasing as the adoption of electric vehicles increases. On the other hand, the ICE-based vehicle market still shows large production volumes, as shown in the ICE Motorcycle Market chart in Figure 1.1. Despite this, the growth of ICE vehicles tends to be stagnant.

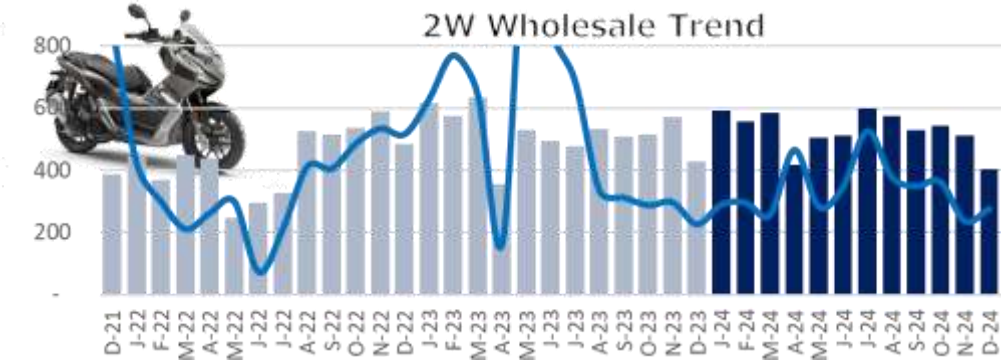

Figure 2 Wholesales Trend 2W, 2024

(Source: AISI data, 2024)

Based on the 2W Wholesale Trend chart, global motorcycle sales conditions in 2023 show a significant recovery trend compared to the previous period (Guillen et al., 2026; Niccolai, 2025; Zhao et al., 2025). Entering 2024, motorcycle sales trends show the same pattern compared to 2023. This condition provides opportunities as well as challenges for the

automotive component industry to improve production efficiency, maintain product quality to meet customer needs (Ghelani, 2023; Hsu et al., 2024; Mendes et al., 2023; Niccolai, 2025; Teplická et al., 2023; Zehra et al., 2024; Zhao et al., 2025).

The selective of QC 7 Tools has proven to be effective in supporting digital transformation that improves efficiency, productivity, and production quality in the automotive components industry. Digitalization systems are designed to have a positive impact to the company's operational and financial performance, and support sustainability by reducing the environmental impact resulting from excessive paper use.

METHOD

As previously noted, the company's main problem was operational inefficiency, particularly in OEE achievement, which affected production output and product quality due to reliance on manual processes. This study aimed to identify and eliminate non-value-added activities and improve production efficiency and quality. Following Ohno (1988), an applied research approach was used to address practical problems in the production system, particularly in the context of digitalization.

A mixed-method approach was employed, collecting qualitative data through in-depth interviews, direct observation, and focus group discussions, as well as quantitative data related to production activities, including activity time, daily worksheet data, machine trouble reports, and reject reports. These data were analyzed to identify patterns and measure process efficiency. The dependent variables were non-value-added (NVA) activity, time, efficiency, and quality, while the independent variables were the digitalization system and the selective QC 7 Tools.

The selective QC 7 Tools were applied to analyze the root causes of low efficiency and quality, primarily using fishbone diagrams to identify non-value-added activities across operator, administrative, and leadership levels. Further analysis was conducted using Why-Why Analysis to explore root causes and enable targeted improvements.

Primary data were collected through direct observation on the production line, interviews with supervisors and stakeholders, and focus group discussions on the application of kaizen and digitalization. Secondary data were obtained from document studies, including production reports, OEE data, and machine records, to analyze problems and ensure compliance with customer specifications.

This study was conducted on a machining production line within the automotive component industry. The population comprised automotive component companies in West Java province, which has the largest concentration of automotive component manufacturers in Indonesia. From this population, one company engaged in the manufacture of engine and transmission components was selected as the research sample.

RESULT AND DISCUSSION

Data Processing and Analysis Results

QC 7 Tools "Problem Identification" Method

At this stage, the researcher identified problems related to efforts to increase productivity without significant resource addition, reduce the rejection rate to minimize waste, and increase efficiency through the elimination of non-value-added activities through process improvement.

One of the indicators that shows the existence of these problems is the Overall Equipment Effectiveness (OEE) value on the production line that has not reached the target set by the company. Based on the data shown in Figure 2.1, the average OEE achievement is only 72%, still below the company's target. This condition indicates that the production process has not run optimally and there is still a potential for inefficiency that can affect productivity and operational effectiveness.

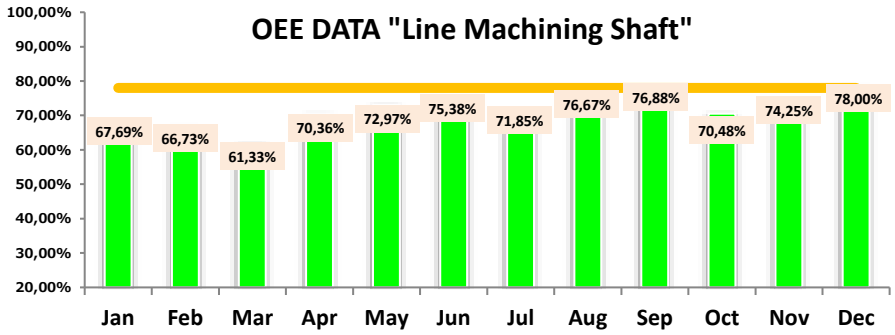

Figure 3 OEE Production Line Achievement Data, 2024
(Source: Internal Data, 2024)

Selective QC 7 Tools "Problem Analysis" Method

From the previous data, a Pie Chart was created to analyze which activities took the most time or resources. Judging from Figure 4.2, 80% of the frequency of daily data management has the greatest burden due to the activity of recording daily worksheets by 31%, recording of deeds by 31% and reports of machine damage by 17%.

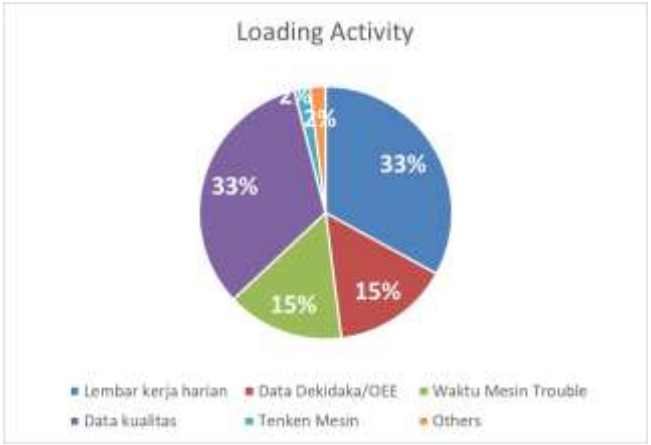

Figure 4 Pie chart of production report frequency
(Source: Internal data, 2024)

At this stage of analysis, a Focus Group Discussion (FGD) was carried out, this was done to obtain input and views from other sections related to the topic of Analysis of current conditions and main problems in the work process This FGD activity was held in April 2024 by involving internal experts, namely the QA Manager and the Head of Production and 2 external experts, namely the IT Manager and senior Engineering staff.

Selective QC 7 Tools "Problem Analysis" Method

From the analysis of the fishbone diagram, it can be concluded that the Man factor (human) spends a lot of manpower for manual data input, Method (method) many manual activities that require a lot of paper and manual data input, Material is the existence of physical documentation that requires storage space, Machine, namely the machine is still manual, not yet integrated with the digital system and Environment (environment) still requires a lot of space and equipment. Inputted data documents are prone to errors, reports are not transparent and easily manipulated so that it is necessary to eliminate non-value-added activities (Non-value-added elimination) because it has an impact on inefficient and ineffective work because there are many operators, a lot of data is inputted manually and requires a lot of paper.

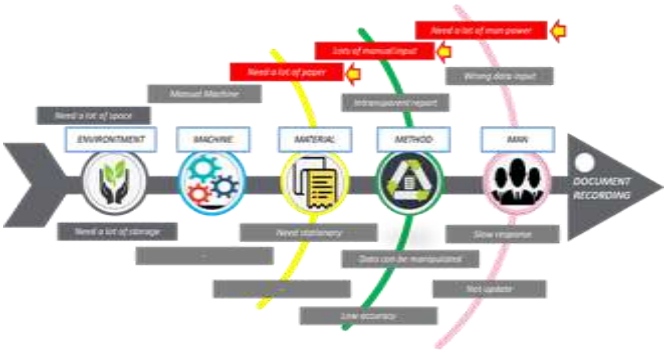

Figure 5 Fishbone Analysis

(Source: Internal data, 2024)

Key Findings

Based on the results of the identification of initial conditions before repair, it was found that in terms of effectiveness and quality, the company's OEE Performance still did not reach the set target of 78%, with an actual average of 72%. Based on the results of the initial analysis using the QC 7 Tools method, this study succeeded in identifying the root problems that contribute to low operational efficiency and production quality. The absence of a system capable of integrating various activities into one integrated system is the root of the main problem. These findings are reinforced through the application of the selective QC 7 Tools method, which shows that the process is still highly dependent on manual systems with a lot of inefficient data inputs. As a result, there is a waste of labor, time, and resources. The implementation of the digitalization system resulted in significant improvements, including the complete elimination of 195 minutes per shift of non-value-added activities, reduction of reporting lead time from 2–3 days to near real-time (0.5 days for analysis), and a 10% increase in OEE performance. Additionally, the system enabled the reallocation of 13 administrative personnel to be value-added.

Industry implications

The findings of this study have a significant impact on improving the performance of the company and the automotive industry in general. From an industry perspective, the implementation of real-time measurement systems has strategic implications for the paradigm shift in operational management, namely the shift from experience-based decision-making to data-driven decision-making. Digital-based monitoring systems allow management to obtain

actual production performance information so that corrective actions can be taken quickly before problems develop into larger production losses. This condition directly contributes to the increase in the value of OEE, the reduction of rejected products, and the efficiency of the company's operational costs.

Furthermore, companies need to instill a culture of continuous improvement by making real-time data the main basis for identifying and solving problems using QC 7 Tools digitally. Once the system proves to be effective on the production line, digitalization can be extended to other departments that still rely on manual processes, such as Quality, PPIC, Maintenance, and Engineering.

Research Limitations

This research has limitations in the scope of the industry and the object of research is focused on the automotive component industry, especially production lines with manual and semi-automatic machines. This causes the results and design of the proposed digitization system to be contextual and cannot necessarily be generalized directly to other industries with different characteristics, levels of automation, and work cultures. In addition, the object of research only includes operators, administrators, and production leaders as the main users, so the perspectives of other parties such as top-level management, engineering teams, and maintenance departments are not fully accommodated, which can limit the holistic picture of the company's digitalization needs. integration with ERP systems, as well as mobile applications, so that this research focuses more on improving efficiency and quality through optimizing the interface and core functions of the digitization system.

CONCLUSION

This study designed a digitalization system to improve work efficiency and production quality in the automotive component industry using the selective QC 7 Tools method. Root cause analysis through 5 Why's revealed that the absence of an integrated system was the primary driver of inefficiency, with QC 7 Tools implementation further confirming that reliance on manual processes generated significant waste in labor, time, and resources. The resulting digitalization system delivered measurable improvements, including the elimination of 195 minutes per shift of non-value-added activities, the reduction of reporting lead time from 2–3 days to near real-time (0.5 days for analysis), a 10% increase in OEE performance, and the reallocation of 13 administrative personnel to more value-added roles. Future research should explore the integration of this system with enterprise-wide platforms such as ERP and quality management systems to establish a more unified data ecosystem, as well as the expansion of digitalization to other departments, including PPIC, Maintenance, and Engineering, to assess its scalability and broader organizational impact.

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