



Literature Review: The Role of Kaizen in Improving the Quality of Automotive Products

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DOI: 10.31004/jutin.v8i4.xx

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Article Info	Abstrak
Keywords: <i>Kaizen;</i> <i>Automotive Industry;</i> <i>Product Quality;</i> <i>Continuous Improvement;</i> <i>Industry 4.0</i>	Abstract Global competition, digital transformation, and rising expectations for product quality all pose challenges for the automotive sector. Kaizen, a concept of continuous improvement that is widely used in manufacturing processes, is one strategic way to address this challenge. The purpose of this study is to examine the role of Kaizen in improving the quality of automotive products by conducting a comprehensive literature review of eleven selected scientific articles from national and international journals. The study found that Kaizen tools such as 5S, Poka-Yoke, PDCA, and Kaizen Costing were successful in reducing production errors and improving process efficiency. However, cultural opposition, inadequate training, and adaptability to digital technologies all pose obstacles to Kaizen adoption. This study shows that the effectiveness of Kaizen depends on management support, employee engagement, and the organization's capacity to incorporate technology into the philosophy of continuous improvement. This research provides a foundation for building a Kaizen strategy in the Industry 4.0 era.

1. INTRODUCTION

The automotive industry is one of the most competitive, dynamic, and highly sensitive manufacturing sectors to quality issues. In the face of global market pressure, increasing consumer expectations, and rapid technological developments, automotive companies are required to continue to improve process efficiency, timeliness, and product quality consistency. Quality is no longer just a technical parameter, but a strategic factor that determines the competitiveness and business continuity of the company in the era of industrial globalization. In this context, a continuous improvement strategy is one of the management approaches that is urgently needed. One of the most popular and proven effective methodologies is Kaizen, a Japanese management philosophy that prioritizes gradual, continuous improvement, and involves all components of the organization. Kaizen is not just a production technique, but a work culture that encourages all individuals to constantly look for ways to improve processes, improve quality, and reduce waste (Sahmi & El Abbadi, 2024).

Various global automotive companies have adopted Kaizen as part of their quality management systems. A study by Siddiqui (2019) shows that the implementation of structured Kaizen Events is able to improve traceability, reduce production defects, and significantly increase operator engagement. Mahmod et al., (2017) also noted that the integration of Kaizen with the Lean Six Sigma approach significantly reduced the production rejection rate by more than 40% in automotive component factories in Malaysia.

Meanwhile, in Indonesia, the implementation of Kaizen is also showing promising results. Research by Prayuda (2020) shows that the application of 5S principles and visual management is able to improve workflows, reduce downtime, and improve work discipline in the automotive OEM sector. A study by Gunawan & Nurbani, (2023) at PT Ibara Lioho Indonesia proves that the collaborative use of Kaizen Costing can help reduce production costs systematically. Other research in the vehicle maintenance and servicing sector, such as that conducted by Ramadhan et al. (2021), highlights the effectiveness of forming an internal Kaizen team in increasing technician productivity at AHASS Surakarta.

However, the success of Kaizen implementation is inseparable from various challenges. Many organizations face resistance to change, a lack of Kaizen literacy at the operator level, and limited integration between Kaizen's manual approach and modern digital systems. As the Industry 4.0 era evolves, important questions arise about how Kaizen can be adapted into manufacturing systems that rely on real-time data, automation, and artificial intelligence. Several studies such as those conducted by Hammerl & Weber (2021) show that there is a gap between traditional Kaizen approaches and the need for quick response in digital systems.

In response to this challenge, the digital Kaizen initiative emerged, an approach that combines the principles of continuous improvement with information technology, digital reporting, and a cloud-based collaborative platform. Zahra & Purwanggono (2024) provide a concrete example of how this approach has been successfully implemented at PT Toyota Motor Manufacturing Indonesia through logistics reporting system reform that has an impact on time efficiency and improved data accuracy.

Although a number of studies have discussed the benefits and challenges of implementing Kaizen in the automotive sector, there is still a gap in the overall understanding of how Kaizen principles can be contextualized in the Indonesian automotive industry environment that is moving towards digital transformation. Therefore, this study aims to examine more deeply the role and effectiveness of the application of Kaizen in improving the quality of automotive products based on a review of the latest scientific literature. This research not only discusses the tools and techniques used, but also highlights organizational cultural factors, implementation challenges, and adaptation strategies to modern industrial technology dynamics. By understanding the best practices, obstacles, and future potential of Kaizen in the automotive context, it is hoped that the results of this study can be a reference for academics, industry practitioners, and policymakers in developing sustainable and adaptive quality improvement strategies in the digital era.

Based on the description above, this study seeks to answer several research questions:

1. What is the role of Kaizen in improving product quality in the automotive industry in the midst of global competition and digital transformation?
2. What Kaizen tools and techniques have proven to be most effective in reducing production errors as well as improving the efficiency of the automotive manufacturing process?

2. METHOD

This study uses a qualitative approach with a systematic literature review method to explore in depth the roles, challenges, and implementation strategies of Kaizen in the automotive industry. This approach was chosen because it is considered the most appropriate to examine managerial and operational concepts that have been applied in various previous studies, both on a national and international scale, without conducting direct experiments in the field.

The data collection process is carried out by browsing through various relevant scientific articles, both from accredited national journals and reputable international journals. The selected articles are scientific publications published within the last five years (2019–2024), to ensure that the data and information analyzed remain contextual and in accordance with the latest developments in the automotive industry, including in facing the challenges of the digital era and Industry 4.0.

The study process begins with the identification and selection of relevant and quality scientific journal articles, both from accredited national journals and reputable international sources. In this process, articles that discuss the implementation of Kaizen directly in the automotive manufacturing environment are screened. From the results of the initial selection, five main articles were obtained that were analyzed thematically. These articles include case studies, theoretical studies, and empirical research that contain information about Kaizen tools such as 5S, Poka-Yoke, Gemba Walks, Kanban, and Kaizen Events, as well as the results of their implementation in improving the quality and efficiency of production.

The analysis process is carried out by reading all articles thoroughly, recording key data, then grouping the data into thematic categories that appear repeatedly. The triangulation technique was used to increase the validity of the study results, namely by comparing findings from various geographical contexts (e.g. Japan, Indonesia, Malaysia, Germany), type of organization (OEM, component supplier, service workshop), and variety of Kaizen tools used.

In the synthesis process, researchers use a narrative synthesis approach, which allows the integration and interpretation of findings from various sources without having to perform statistical quantification. This approach is particularly appropriate for explaining managerial concepts such as Kaizen, as it allows for an in-depth analysis of the relationship between the organizational context, work culture, and the success of the improvement strategy.

Overall, this method aims to build a complete, contextual, and evidence-based understanding of how Kaizen is implemented in the automotive industry, as well as how companies are facing challenges and opportunities amid technological changes and global market pressures. The results of this analysis are then used as a basis for drawing conclusions and providing recommendations that can be applied by practitioners and researchers in the field of industrial engineering and operations management.

3. RESULT AND DISCUSSION

Table 1. Comparative Summary of Kaizen Studies in Automotive Industry

Study	Country	Key Focus	Kaizen Tools	Main Impact
Sahmi & El Abbadi (2024)	Morocco	Kaizen Culture	General	Mindset change
Prayuda (2020)	Indonesia	OEM Automotive	5S, Gemba	Reduced downtime
Siddiqui (2019)	India	Kaizen Event	Layout, 5S	Increased traceability
Mahmod et al. (2019)	Malaysia	Lean-Kaizen	Poka-Yoke	Decreased production rejection
Hammerl & Weber (2021)	Germany	Innovation	Gemba	Faster design iteration
Erviyana et al. (2024)	Indonesia	Ban motor	PDCA	Reduction of test defects
Sumasto et al. (2023)	Indonesia	Component	PDCA	Quality control improvements
Gunawan & Nurbani (2023)	Indonesia	Spare parts	Kaizen Costing	Cost efficiency
Zahra & Purwanggono (2024)	Indonesia	TMMIN	PDCA	Lead time decreased
Ramadhan et al. (2021)	Indonesia	AHASS Workshop	5S, Tim Kaizen	Increased productivity
Putro (2020)	Indonesia	Mobile maintenance	Standardization	Time & cost efficiency

1. Effectiveness of Kaizen Tools in Automotive Quality Improvement

The application of Kaizen tools and techniques has been proven to have a significant impact on improving product quality, process efficiency, and reducing waste in the automotive industry. Studies have shown that tools such as 5S, Poka-Yoke, Kanban, Kaizen Events, as well as the PDCA (Plan-Do-Check-Act) approach are key components of a continuous improvement strategy. One of the most striking studies is the one conducted by Siddiqui (2019) through the implementation of the Kaizen Improvement Event K-188. This study illustrates how the use of 5S and the improvement of the work layout has been successful in improving traceability, reducing defects, and speeding up workflows in the automotive component production line in India. These results are reinforced by Mahmod et al., (2017) who found that the integration between Kaizen and Lean Six Sigma was able to reduce the production rejection rate by more than 40% in Malaysian automotive companies, through the implementation of Poka-Yoke and a structured Kanban system.

In the Indonesian context, Prayuda (2020) noted that the application of 5S and visual management in automotive OEMs has a significant impact on tidying up work areas, reducing waiting times, and accelerating decision-making on the production floor. This effectiveness is also shown by Hessa et al. (2021) who reported the success of using the Kaizen technique in the surface booth process at one of the Karawang automotive factories. This implementation focuses on reducing cycle time and improving the consistency of paint results, which greatly contributes to the stability of product quality.

In addition to conventional tools, the PDCA cycle-based approach is also becoming a strategy that is increasingly being applied, especially in the vehicle components and testing industries. Erviyana et al. (2024) showed that the application of PDCA at the motorcycle tire testing stage was able to significantly reduce the number of test errors, improve the reporting system, and improve quality data traceability. A similar study by Sumasto et al. (2023) on the automotive component industry confirmed that PDCA is effective in formulating concrete improvement measures, with results in the form of reducing product defects and improving compliance with work standards.

In principle, the effectiveness of Kaizen tools is closely related to oFurthermore, the combination of Kaizen tools and digitalization is starting to emerge as a future solution. For example, in a study by Zahra & Purwanggono (2024), the PDCA approach was used to standardize the logistics reporting format at PT Toyota Motor Manufacturing Indonesia. The results show that the use of this technique successfully lowers reporting lead times and improves the efficiency of information flows in complex and dynamic work environments.

From these findings, it can be concluded that the effectiveness of Kaizen tools and techniques does not only lie in the type of tools used, but also in the way they are consistently applied, supported by training, managerial supervision, and employee involvement. The combination of technical tools and a soft management approach is the main key to the successful implementation of Kaizen in the automotive sectoroperational discipline and worker involvement on the front line. Sahmi & El Abbadi (2024) emphasize that the success of these tools is largely determined by the extent to which the organization is able to build a work culture that supports continuous improvement. Tools like 5S not only serve as a method of cleanliness and order, but also as a means to form a mentality of discipline and ownership of the work process.

Furthermore, the combination of Kaizen tools and digitalization is starting to emerge as a future solution. For example, in a study by Zahra & Purwanggono (2024) the PDCA approach was used to standardize the

logistics reporting format at PT Toyota Motor Manufacturing Indonesia. The results show that the use of this technique successfully lowers reporting lead times and improves the efficiency of information flows in complex and dynamic work environments. From these findings, it can be concluded that the effectiveness of Kaizen tools and techniques does not only lie in the type of tools used, but also in the way they are consistently applied, supported by training, managerial supervision, and employee involvement. The combination of technical tools and a soft management approach is the main key to the success of the sustainable implementation of Kaizen in the automotive sector.

2. Cultural and Organizational Impact

The success of Kaizen implementation in the automotive industry depends not only on the use of technical tools such as 5S, Kanban, or Poka-Yoke, but is also highly determined by the organization's culture and the level of employee involvement in the improvement process. Kaizen is not just a set of techniques, but a work philosophy that emphasizes collaboration, ownership, and continuous learning at all levels of the organization. Some studies state that Kaizen becomes effective when organizations are able to build a culture that supports grassroots initiatives. Sahmi & El Abbadi (2024) in their systematic review stated that a mindset change towards a culture of continuous improvement is essential to maintain long-term implementation results. Without the support of organizational structure and leadership, Kaizen tools tend to be mere formalities with no real change in daily practice.

This is reinforced by Hammerl & Weber (2021) in a case study in the German automotive industry that emphasizes the importance of a bottom-up approach in Kaizen. They showed that when employees were given space to share ideas, participate in Gemba Walks, and participate in improvement forums, engagement rates increased. As a result, small innovations emerge but have a big impact on productivity and product quality. The implementation of a suggestion system, work rotation, and visual feedback has helped shape an organizational culture that is more adaptive and responsive to problems in the field.

In the Indonesian context, Gunawan & Nurbani (2023) observed the implementation of Kaizen Costing at PT Ibara Lioho Indonesia which focuses on cost efficiency. The success of this method cannot be separated from collaboration between departments and the active involvement of all team members in identifying and overcoming process waste. Employees who have an understanding of the company's performance targets and are given the autonomy to make local improvements will be more motivated to actively contribute to improving efficiency.

Ramadhan et al. (2021) in their study at the AHASS workshop of PT Cahaya Sakti Motor Surakarta also emphasized the importance of forming an internal Kaizen team as a driving force for change. This team consists of technicians, supervisors, and workshop heads who routinely discuss service improvements, productivity, and vehicle service cycle times. The results show an increase in technician productivity and consistency in the quality of customer service.

Cultural factors are also seen in the study of Prayuda (2020), who found that the successful implementation of 5S in local automotive factories depends not only on technical training, but also on habituation of disciplined behavior and ownership of work areas. When workers feel that the work area is a personal responsibility, the sustainability of the Kaizen program becomes more maintained.

However, some cultural challenges were also identified. In many companies, resistance is still found from middle managers who feel that improvement initiatives from the lower levels threaten their authority (Sahmi & El Abbadi, 2024). In addition, the lack of recognition of individual or team contributions is also an obstacle in maintaining the motivation of workers to continue to innovate. Faced with these challenges, companies that successfully implement Kaizen sustainably generally have a clear reward system, open lines of communication between workers and management, and the integration of a culture of improvement into new employee onboarding and HR development programs. Thus, it can be concluded that Kaizen will not succeed optimally if it is separated from the context of organizational culture and employee engagement. The combination of training, managerial support, and employee empowerment is the main foundation in creating a responsive, productive, and sustainable work culture. A successful implementation of Kaizen will ultimately create a learning organization, where every employee has an active role in maintaining and improving the quality of products and work processes.

3. Adaptation to Technology and the Industrial Era 4.0

The rapid development of digital technology and the emergence of the Industry 4.0 era have created new challenges as well as opportunities for Kaizen practices in the automotive industry. On the one hand, Kaizen is known as a gradual approach that focuses on small, continuous improvements. On the other hand, Industry 4.0 demands rapid transformation based on automation, data integration, and artificial intelligence. The tension between incremental approaches and real-time innovation demands is an important issue that needs to be studied further. Hammerl & Weber (2021) highlight that many automotive companies have difficulty integrating Kaizen principles into high-tech-based production systems. They found that manual approaches such as Gemba Walks and suggestion boards often run separately from ERP systems and digital dashboards. This leads to a gap between data collected in the field and real-time data-driven strategic decision-making.

However, some recent studies show that Kaizen remains relevant and can actually be strengthened with digital technology if it is adapted strategically. One prominent example is a study by Zahra & Purwanggono (2024) at PT Toyota Motor Manufacturing Indonesia (TMMIN). In the study, the PDCA approach was applied to standardize logistics reporting formats, which were previously manual and non-uniform. After the Kaizen-based digitization process, the lead time can be significantly reduced, and information can be passed on to decision-makers faster.

The concept of Digital Kaizen began to develop as a form of adaptation of the classical philosophy. Digitalization does not replace the basic principles of Kaizen, but rather strengthens it through the integration of technologies such as the Internet of Things (IoT), machine sensors, cloud-based analytics, and real-time feedback systems. With the help of a data-driven monitoring system directly from the production floor, the problem identification process no longer relies on manual observation alone, but is supported by visual and predictive analysis. Fauzi & Prasetyo (2022) in their study on the automotive component industry in West Java also found that the integration of Kaizen training with a digital reporting system accelerates the improvement cycle. Employees not only report problems in writing, but also use cloud-based apps to upload photos of work area conditions, record the time of the incident, and make recommendations for corrective action in person.

Digital transformation also has an impact on the way companies design and manage improvement projects. Gunawan & Nurbani (2023) reveal that Kaizen Costing can be optimized with the use of interactive spreadsheets and automated financial simulations. This allows for a quick and accurate evaluation of cost savings, as well as accelerating approval from management for the implementation of improvement ideas. However, the integration of Kaizen and technology is not without its obstacles. Many companies are still grappling with low digital literacy among field workers, as well as a lack of interoperability between legacy systems and new platforms. Bridging this gap requires multi-level training, the development of an easy-to-understand visual dashboard, and alignment between management policies and technical work practices. It is also important to note that the adaptation of Kaizen in the Industry 4.0 era is not only about technology, but also about the speed and flexibility of organizations in responding to changes. The new version of Kaizen should emphasize agility, the ability to adapt quickly to market and technological dynamics. Therefore, the integration between the principles of continuous improvement and digital tools must be designed in a cross-functional, collaborative, and data-driven framework. Overall, it can be concluded that Kaizen has not lost its relevance in the digital age, but it demands a redefinition. The implementation of Kaizen that is adaptive to Industry 4.0 will involve the use of real-time data, sensor-based monitoring, interactive dashboards, and digital collaborative platforms. Automotive companies that successfully combine the philosophy of incremental improvement with technological excellence will be in a stronger position to compete in an ever-changing global marketplace.

4. Implementation Barriers and Improvement Strategies

While the implementation of Kaizen has proven to make a tangible contribution to improving quality and efficiency in the automotive industry, many organizations face various obstacles in the implementation and sustainability stages. These barriers are not only technical, but also cultural and structural, especially when organizations have not yet fully understood the Kaizen philosophy as a holistic approach and not just an operational technique. One of the most common barriers reported by many studies is resistance to change, both among operators and middle management. Sahmi & El Abbadi (2024) note that line managers often show passivity or even resist improvement initiatives because they feel a threat to established authority or work patterns. This defensive attitude hinders the realization of the open work culture required by Kaizen.

In addition, the lack of a deep understanding of the principles of Kaizen is also a major problem, especially if the training is only given formally without practical assistance in the field. In Prayuda (2020) study, it was found that many workers only follow the 5S procedure mechanically without understanding its meaning and benefits. This makes the practice of Kaizen temporary and unsustainable because it does not grow from individual consciousness. Another obstacle is the lack of systematic support from top management. While Kaizen initiatives often start from the bottom-up, their success relies heavily on management's commitment to providing resources, time, and incentives for employees to make continuous improvements. Without a specific budget allocation or a supportive incentive structure, many improvement ideas cannot be implemented.

In the context of digital transformation, the inequality of technological competence is an additional challenge. Hammerl & Weber (2021) observed that many automotive companies fail to align between conventional Kaizen practices and modern digital systems due to the lack of integration between manual data in the field and ERP systems or digital dashboards. This causes bottlenecks in decision-making and lowers the accuracy of process monitoring.

In response to these various obstacles, a number of enhancement strategies have been identified in various studies. One effective strategy is to form a cross-functional internal Kaizen team, as done by Ramadhan et al. (2021) at AHASS PT Cahaya Sakti Motor Surakarta. This team functions as a driving force for improvement that is responsible for conducting routine evaluations of performance and proposing improvements based on real data in the field. With a team of technicians and supervisors, the process of identifying problems becomes faster and the resolution is more on target.

Another strategy that has proven successful is the standardization of PDCA-based processes as implemented by Putro (2020) at PT Indomobil Trada Nasional. By adapting Kaizen principles to lower vehicle service lead times, companies are able to save time and costs significantly. This result was obtained thanks to the strengthening of technical training, visualization of work targets, and quantitative performance measurement. In the study by Gunawan & Nurbani (2023), the strategy used was the implementation of Kaizen Costing with the direct involvement of all departments in cost efficiency planning and reporting. This strategy creates transparency, encourages synergy between departments, and forms a strong culture of accountability.

For the context of digitalization, Zahra & Purwanggono (2024) shows the importance of simplifying the reporting format using a digital system that is easy to understand by all levels of employees. Technology training is carried out in stages with a contextual approach to make it more acceptable to workers on the production line. Another improvement strategy that also needs to be considered is the appreciation of employee contributions. Giving recognition, both material and non-material, for improvement initiatives has been proven to increase motivation and a sense of belonging. In organizations that successfully implement Kaizen, incentive systems are designed to encourage active participation and facilitate collective organizational learning. Thus, it can be concluded that the challenges of Kaizen implementation can be overcome through a systemic approach that touches on aspects of training, culture, leadership, and technology. A structured, data-driven, and cross-functional collaboration-oriented improvement strategy has proven to be able to make Kaizen a practice that not only survives, but also thrives in the midst of increasingly complex and digital automotive industry dynamics.

4. CONCLUSION

This literature review shows that Kaizen remains a relevant and strategic approach in efforts to improve quality and efficiency in the automotive industry, both in a global and national context. The use of tools such as 5S, Poka-Yoke, Kanban, Gemba Walks, and PDCA cycles has been proven to reduce product defects, speed up cycle times, and encourage worker involvement in the continuous repair process.

However, the effectiveness of Kaizen does not only depend on technical application alone, but also on organizational culture factors and employee participation. The studies analyzed show that the success of implementation is largely determined by managerial support, the formation of a continuous improvement mindset, and a reward system that drives initiatives from below.

In facing the Industry 4.0 era, Kaizen needs to adapt to digital reality. Integration with technologies such as real-time monitoring systems, digital reporting platforms, and data-driven analytics is important so that the principle of continuous improvement remains relevant. The concept of digital Kaizen is a bridge that allows companies to combine traditional disciplines with the speed and accuracy of digitalization.

Implementation challenges such as resistance to change, low Kaizen literacy, and inequality of technological competence are still the main obstacles. However, strategies such as cross-functional team building, PDCA-based standardization, and context-based training approaches have proven effective in addressing these barriers.

Therefore, it can be concluded that the future of Kaizen in the automotive industry is largely determined by its ability to transform strategically in both cultural, technological, and work system aspects. With a combination of Kaizen's philosophical foundation and the use of digital innovation, automotive companies will be able to maintain a sustainable competitive advantage amid increasingly complex global challenges.

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