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Assessing the Effect of Kaizen Practices on Operational Efficiency: A Case Study of a Steel Manufacturing Company in Zambia

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Abstract

This study evaluates the effect of Kaizen practices on operational efficiency at a steel manufacturing company in Zambia, employing a mixed-method research design. Data were collected through semi-structured interviews, structured questionnaires, and direct observations. Questionnaires were distributed to 317 employees, achieving an 83.3% response rate, and interviews were conducted with 8 key participants. Quantitative data were analyzed using descriptive and inferential statistics, including correlation, regression analyses, t-tests, and ANOVA, while qualitative data underwent thematic analysis. Results indicate that 5S, Total Productive Maintenance (TPM), and Total Quality Management (TQM) significantly improved production cycle times, defect rates, equipment downtime, and costs. Regression analysis revealed that TQM and TPM contributed 30% to efficiency gains, followed by 5S (25%) and 5W1H (20%). t-tests confirmed statistically significant improvements in key metrics post-Kaizen implementation, and ANOVA highlighted inter-departmental variations in adoption rates. Barriers such as inadequate resources, insufficient training, and resistance to change were identified. Recommendations include strengthening training programs, enhancing leadership commitment, and allocating sufficient resources. Prospects for future research include exploring Kaizen's application in diverse industries, examining its long-term effects, and integrating advanced technologies. This study underscores the transformative potential of Kaizen practices and provides actionable insights for enhancing operational efficiency in manufacturing contexts.

Keywords: Kaizen, operational efficiency, 5S, Total Quality Management, 5W1H, Total Productive Maintenance

1. Introduction

According to Zambia's Eight National Development Plan, the manufacturing sector has been identified as one of the key drivers to economic growth and transformation. GDP growth rate for 2023 stood at 5.8%. At the same time, the manufacturing sector's contribution to GDP was 8.3% against the target of 36.1% as envisioned in the Vision 2030 (Zambia Development Agency, 2024). The Zambia Association of Manufacturers (ZAM) reported that manufacturing growth in Zambia fluctuated from 13.1% in 2021 to a meager 1.5% in 2023. In the steel subsector, Zambia's exports slumped from USD 328 million in 2022 to USD 193.6 million in 2023 ((Anon., 2024). The foregoing export figures exemplifies the steel subsector's integral part in Zambia's manufacturing sector. The failure to sustain growth highlights the urgent need for strategic interventions like Kaizen, which emphasizes continuous improvement through structured problem-solving methods. Kaizen, a continuous improvement philosophy, has been widely adopted across industries to enhance operational efficiency. While evidence of Kaizen's effectiveness abounds in developed economies, its application and outcomes in Zambia's manufacturing sector remain underexplored. This study examines its application in a steel manufacturing company in Zambia, focusing on key practices: 5S, TPM, TQM, and 5W1H. The research aims to evaluate the effect of these practices on operational performance and identify challenges to implementation.

1.1. Problem Statement

Zambia's Eighth National Development Plan identifies the manufacturing sector as a pivotal driver of economic growth and transformation. Despite achieving a GDP growth rate of 5.8% in 2023, the manufacturing sector's contribution to GDP was only 8.3%, far below the Vision 2030 target of 36.1% (Zambia Development Agency, 2024). The sector's contribution to nominal GDP growth was a modest 0.2%, with growth rates fluctuating from 13.1% in 2021 to just 1.5% in 2023 (Ministry of Finance and National Planning, 2023). Within the steel subsector, export revenues declined from USD 328 million in 2022 to USD 193.6 million in 2023, underscoring the challenges faced by this critical industry (Anon., 2024).

Such stagnation reflects deeper systemic inefficiencies, including outdated operational practices, inconsistent maintenance, and high defect rates, particularly within the steel subsector. A Zambian steel manufacturing company, which has adopted Kaizen practices such as 5S, Total Productive Maintenance (TPM), and Total Quality Management (TQM), continues to face these challenges. Equipment breakdowns, inconsistent maintenance schedules, and product defects have undermined its ability to meet production targets and contribute effectively to the manufacturing sector's growth.

Although Kaizen is recognized for fostering continuous improvement, there remains limited empirical evidence of its effect on operational efficiency in Zambia's manufacturing context. Existing studies highlight the need for structured operational frameworks to address inefficiencies but provide little insight into Kaizen's practical implementation and outcomes (Sichinsambwe, 2019; Ndhlovu & Chirwa, 2021).

This study seeks to fill this gap by evaluating the effectiveness of Kaizen practices in improving operational efficiency at the anonymized steel manufacturing company. By examining adoption rates, performance metrics, and implementation challenges, the research aims to provide actionable recommendations to enhance efficiency and competitiveness in Zambia's manufacturing sector.

1.2. Research Objectives

1. Assess the awareness and adoption levels of Kaizen practices among employees at the steel manufacturing company.
2. Evaluate the effect of Kaizen practices (5S, TPM, TQM, and 5W1H) on key operational efficiency metrics, including production cycle time, defect rates, equipment downtime, and operational costs.
3. Identify challenges encountered during the implementation of Kaizen practices.
4. Provide actionable recommendations to enhance the effectiveness of Kaizen practices.

2. Literature Review

This section focusses on theoretical background and empirical reviews relevant to the research objectives.

2.1. The Concept of Kaizen

Kaizen, a term derived from the Japanese words "Kai" (change) and "Zen" (good), signifies continuous improvement. It is a participatory approach that aims to enhance quality and productivity incrementally and economically. Originating in Japan, Kaizen has been adapted globally and is recognized for its role in fostering continuous, incremental improvements across various organizational aspects (Hosono, et al., 2020). The philosophy encompasses several techniques, including Kanban, Total Productive Maintenance (TPM), Six Sigma, and others. Techniques such as PDCA (Plan-Do-Check-Act), 5S (Sort, Set in order, Shine, Standardize, Sustain), and the 5 Whys are central to Kaizen's methodology for improving performance (Liker, 2020).

2.2. Operational Efficiency

Operational efficiency is a critical metric that reflects an organization's capacity to utilize its resources such as labor, materials, and capital effectively while minimizing waste and maximizing productivity. This concept is essential for any firm striving to maintain a competitive edge, particularly in industries where cost management and customer satisfaction are pivotal (Slack, et al., 2019). The ability to transform inputs into outputs efficiently can significantly impact a company's profitability and market position. For example, operational efficiency encompasses various elements such as process design, employee productivity, technology adoption, and management practices, all of which contribute to how well a company performs its core functions (Heizer, et al., 2020).

One of the key components of operational efficiency is process design, which involves structuring and organizing workflows to enhance performance. Efficient process design reduces unnecessary steps, streamlines operations, and minimizes delays, thus contributing to higher productivity and lower operational costs. Employee productivity also plays a crucial role; a well-trained and motivated workforce can operate more efficiently, leading to improved output and reduced waste. Technology adoption further impacts efficiency by automating processes, enhancing accuracy, and facilitating better resource management (Bortolotti et al, 2020). Effective management practices ensure that resources are

allocated optimally, goals are clearly defined, and performance is monitored regularly to identify and address inefficiencies. Continuous improvement methodologies, such as Kaizen, have been shown to be particularly effective in enhancing operational efficiency. Kaizen, which emphasizes incremental and continuous improvements, helps organizations systematically address inefficiencies and refine processes over time (Liker, 2020). By involving all employees in the improvement process, Kaizen fosters a culture of collective problem-solving and innovation. This approach enables organizations to make small, manageable changes that can lead to significant gains in efficiency. For instance, Kaizen practices like the 5S methodology (Sort, Set in order, Shine, Standardize, Sustain) and PDCA (Plan-Do-Check-Act) cycle provide structured frameworks for enhancing workplace organization and process management (Liker, 2020).

2.3. Theoretical Framework

The theoretical framework provided the foundational theories and concepts that underpinned the study. Theories derived from extensive research were used to understand the research problem, analyze the data, and make interpretations. In the context of this study, two main theories (TQM and Leam Manufacturing) were used as theoretical basis for assessing the effect of Kaizen on operational efficiency in manufacturing, supported by another relevant theory, Organizational Learning Theory, to assess how employees shared information at all levels in the implementation of Kaizen practices such as Total Productive Maintenance.

Total Quality Management (TQM)

Total Quality Management (TQM), developed by Feigenbaum (1991) and influenced by Deming, Juran, and Ishikawa, is a management approach that focused on long-term success through customer satisfaction by involving all members of an organization in continuous improvement. Previous studies, such as those by Talib et al. (2010) and Hosono et al. (2020), demonstrated how TQM principles improved operational efficiency and customer satisfaction. In this study, TQM was applied to evaluate how continuous improvement, employee involvement, and process optimization at the Steel plant enhanced efficiency and customer satisfaction.

Lean Manufacturing

Lean Manufacturing, introduced by Taiichi Ohno, Shigeo Shingo, and Eiji Toyoda through the Toyota Production System, focuses on eliminating waste and optimizing production processes to maximize customer value. Studies like Liker (2020) explored how Lean principles, such as Just-In-Time, Kaizen, and Jidoka, reduced waste and improved operational efficiency. This study used Lean Manufacturing to examine how the Steel plant implemented waste reduction and continuous improvement techniques to enhance productivity and operational flow.

Organizational Learning Theory

Organizational Learning Theory, pioneered by Argyris and Schön (1978), emphasized the importance of continuous learning and adaptation within organizations. This theory was applied to assess how a culture of learning and knowledge sharing at the Steel plant, fostered through Kaizen practices, improved operational performance and employee engagement.

2.4. Empirical Review

Studies have demonstrated that Kaizen practices significantly improve operational efficiency by reducing cycle times, defect rates, and costs (Hamad & Karuppusami, 2019; Sarkar, 2021). However, inconsistent implementation and insufficient training often undermine their effectiveness, particularly in resource-constrained settings (Sichinsambwe, 2019).

Mexico: Kaizen interventions have proven highly effective in various industries across Mexico, particularly in manufacturing. A notable example is the application of 5S - a workplace organization method designed to increase efficiency by eliminating waste and improving flow. In Mexico, companies that implemented Kaizen, particularly the 5S technique, experienced significant reductions in defects and improvements in job throughput. This led to enhanced product quality and reduced operational costs. According to Hosono et al. (2020), the structured approach to workplace organization allowed for better use of resources and increased employee accountability, ultimately boosting operational performance. These improvements were attributed not only to Kaizen's systematic methodologies but also to the participatory approach that encouraged employees to take ownership of problem-solving efforts, a key element in maintaining continuous improvement.

Romania: In Romania, the implementation of 5S at Hirschmann Automotive, a cable production company, directly contributed to substantial productivity gains. The introduction of Kaizen practices allowed the company to optimize its production processes, particularly in cable manufacturing, which resulted in increased output and fewer production bottlenecks. As Veres et al. (2022) indicate, the focus on continuous improvement through Kaizen not only improved overall operational efficiency but also enhanced workplace safety by fostering an organized and hazard-free environment. The success of the 5S method in this Romanian case study highlights the global applicability of Kaizen methodologies, irrespective of industry or geography, and emphasizes the importance of tailored approaches to specific industrial needs.

India: In India, the adoption of Kaizen practices, particularly in the manufacturing sector, has also yielded significant operational improvements. A plastic machinery manufacturing firm that implemented Kaizen principles, specifically 5S and PDCA, saw measurable increases in both productivity and employee morale. The firm reported an increase in operational efficiency, rising from 75% to 101%, demonstrating the effectiveness of Kaizen in fostering a positive shift in work culture. As Makwana and Patange (2019) report, the key to the firm's success was its ability to incorporate Kaizen's continuous improvement philosophy at all levels of the organization (Makwana & Patange, 2019). By encouraging workers to engage actively in identifying inefficiencies and proposing solutions, the company was able to streamline its operations and reduce waste. This case underscores the ability of Kaizen to drive both tangible productivity improvements and intangible benefits such as increased job satisfaction.

Indonesia: In the Indonesian mining sector, Kaizen has also been instrumental in driving operational improvements. A study by Prawira et al. (2022) demonstrated how Kaizen-driven changes at a mining company led to reductions in both maintenance time and operational costs. By employing tools like 5W1H and the Ishikawa Diagram, the company was able to systematically analyze and address inefficiencies in its maintenance processes. This not only resulted in cost savings but also improved employee morale, as workers were actively involved in identifying and resolving issues (Prawira, et al., 2018). The participatory nature of Kaizen, coupled with its focus on incremental improvements, enabled the company to enhance operational efficiency without the need for significant capital investment. This case highlights the versatility of Kaizen practices in different industrial contexts and their capacity to deliver both short-term gains and long-term cultural shifts towards continuous improvement.

Ghana: In Ghana, the adoption of Kaizen practices has had a profound effect on the performance of manufacturing firms. A study conducted by Hosono et al. (2020) highlighted significant improvements in operational efficiency, with firms reporting notable reductions in equipment downtime and increases in overall productivity. The use of 5S and Total Productive Maintenance (TPM) techniques in the Ghanaian context allowed manufacturers to streamline operations, eliminate waste, and optimize their use of resources. In addition to reducing downtime, these firms experienced enhanced product quality as a direct result of Kaizen's focus on continuous improvement. This success in Ghana's manufacturing sector has prompted widespread interest in Kaizen as a viable solution for addressing industrial inefficiencies in other African countries.

One notable case study from Ghana involved the application of Kaizen in the food processing industry, where companies used the PDCA cycle (Plan-Do-Check-Act) to improve workflow and reduce delays in production. As a result, firms saw a 20% improvement in processing times and significant reductions in the defect rates of their products. The study also emphasized the importance of worker engagement in the Kaizen process, as employees were encouraged to participate actively in identifying inefficiencies and proposing solutions. The participatory nature of Kaizen empowered workers to take ownership of the improvement process, which fostered a culture of accountability and sustained performance gains (Hosono et al., 2020).

Kenya: Similar successes have been recorded in Kenya, where Kaizen has been widely adopted in both the public and private sectors. According to Mano et al. (2023), Kenyan manufacturing firms that embraced Kaizen methodologies, particularly 5S and Kanban systems, saw significant operational improvements. These improvements were particularly evident in the reduction of waste and enhanced workplace organization, which resulted in better product quality and faster turnaround times. In the Kenyan textile industry, for example, firms that adopted Kaizen practices reduced fabric waste by 30%, leading to cost savings and improved production efficiency. The systematic application of Kaizen's 5S principles helped companies achieve a more organized and efficient production environment, which in turn reduced machine breakdowns and minimized idle time.

2.5. Conceptual Framework

The conceptual framework for this study illustrates the relationship between Kaizen practices and operational efficiency. Kaizen practices, including 5S, TPM, TQM, and 5W1H, serve as independent variables, while key operational efficiency metrics (production cycle time, defect rates, equipment downtime, and operational costs) represent the dependent variables. Mediating factors such as employee engagement, training, and resource availability influence this relationship. Challenges such as resistance to change and insufficient training are considered moderating factors. This framework guides the analysis of how the implementation of Kaizen practices affects operational efficiency and identifies areas for improvement. The conceptual framework is illustrated in Figure 1.

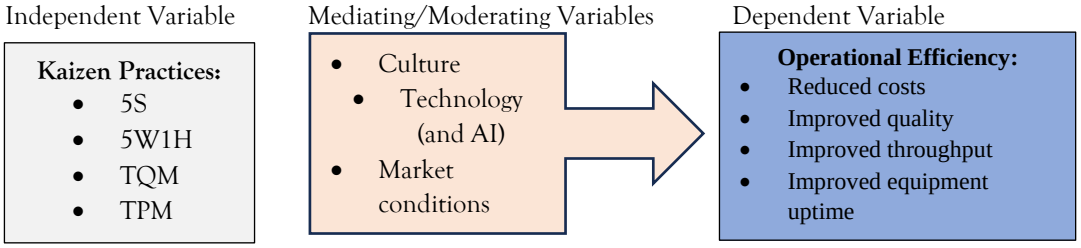

Figure 1: Conceptual framework

3. Research Methodology

3.1. Research Design

This study employed a convergent parallel mixed-method research design, which integrated both qualitative and quantitative data collection methods. This approach allowed for the simultaneous gathering of qualitative and quantitative data, which were then analyzed separately and merged at the interpretation stage (Creswell & Clark, 2017). By using this design, the study aimed to provide a more comprehensive understanding of the effect of Kaizen practices on operational efficiency. The qualitative component explored the relationships between Kaizen practices and operational efficiency through interviews and focus group discussions with selected employees. The quantitative component involved a survey of employees, collecting descriptive data to statistically test the formulated hypotheses.

3.2. Data Collection

Data collection involved multiple methods to ensure the reliability and validity of findings:

Semi-Structured Interviews: Conducted with 8 key participants, including senior managers and the Kaizen champion, to gain in-depth insights into the practical application and challenges of Kaizen practices. Each interview lasted approximately 45 minutes and followed a semi-structured format to allow for both guided and open-ended responses.

Structured Questionnaires: Distributed to 317 employees across various departments, including production, maintenance, and quality assurance. The questionnaire consisted of 21 questions grouped into sections covering awareness, adoption, challenges, and perceived effects of Kaizen practices. A response rate of 83.3% was achieved, with 264 completed questionnaires returned and analysed.

Direct Observations: Manufacturing processes were observed over a two-week period to assess the real-time application of Kaizen tools such as 5S, TPM, and 5W1H. Observations focused on key metrics like production cycle times, equipment maintenance schedules, defect rates, and workplace organization.

Document Analysis: Internal records, including maintenance logs, defect reports, training attendance sheets, and Kaizen project reports, were reviewed to corroborate primary data and identify trends in operational performance before and after Kaizen implementation.

3.3. Data Analysis

Quantitative data were analyzed using a systematic approach to ensure robustness and accuracy:

Descriptive Statistics: Metrics such as mean, standard deviation, and percentages were calculated to provide an overview of awareness levels, adoption rates, and key operational outcomes.

Correlation Analysis: Used to explore the relationships between Kaizen practices and operational efficiency metrics, highlighting significant associations.

Regression Analysis: Conducted to determine the contribution of individual Kaizen practices (5S, TQM, TPM, and 5W1H) to overall operational improvements. The model's adjusted R-squared value indicated the extent to which these practices explained variance in efficiency.

Inferential Statistics: t-tests and ANOVA were employed to assess the statistical significance of observed differences in performance metrics before and after Kaizen implementation.

Qualitative data were analyzed through thematic analysis:

Coding Framework: Data from interviews and observations were coded using NVivo software to identify key themes such as "awareness," "implementation challenges," and "employee perceptions."

Theme Integration: Themes were integrated to provide a narrative on the synergetic effects of Kaizen tools and their implementation dynamics.

Validation: Triangulation was employed by comparing qualitative findings with quantitative results and document analysis to enhance credibility.

4. Results

4.1. Awareness and Adoption of Kaizen Practices

Table 1 summarizes awareness and adoption levels of Kaizen practices:

Practice	Awareness (%)	Adoption Rate (%)
5S	85%	90
TQM	75%	80
TPM	75%	70
5W1H	60%	60

Consequent to awareness and adoption levels, participation levels of employees in Kaizen activities revealed similar results as summarized on Table 2:

Activity	Frequency of Participation (%)
Weekly Meetings	65%
Problem-Solving Sessions	50%
Continuous Improvement Events	70%

4.2. Effect on Operational Efficiency

Key performance improvements are presented in Table 3:

Metric	Before Kaizen Implementation	After Kaizen Implementation	Improvement (%)
Production Cycle Time	8 hours	6 hours	25
Defect Rate	8%	4%	50
Equipment Down Time	15%	8%	46.7
Operational Costs	$50,000/month	$40,000/month	20

Regression analysis revealed that TQM and TPM had the strongest effect, contributing to a 30% improvement in efficiency, followed by 5S (25%) and 5W1H (20%).

Descriptive Statistics of Efficiency Metrics

The findings presented in Table 4, indicate mean production cycle time of 8.2 hours, with a low standard deviation of 1.5, suggesting consistency in performance. The average defect rate of 3.2% and equipment downtime of 12.5% highlight opportunities for improvement. The relatively small variation in these metrics indicates stable yet suboptimal operations.

Metric	Mean	Median	Standard Deviation
Production Cycle Time (hrs)	8.2	8	1.5
Defect Rate (%)	3.2	3.1	0.8
Equipment Downtime (%)	12.5	12	3.2

Predictive Power of Kazen Practices for Operational Efficiency

The regression analysis presented in Table 5, highlights that 5S and TPM ($\beta = 0.35$) and TQM ($\beta = 0.45$) have the strongest predictive power for operational efficiency improvements. The R^2 value of 0.40 indicates that 40% of the variability in efficiency metrics can be explained by these Kaizen practices. This underscores their critical role in driving performance gains.

Variable	Beta Coefficient	p-value	R^2
5S Practices	0.35	<0.001	0.40
TQM Practices	0.45	<0.001	0.40
5W1H Tools	0.25	0.02	0.40
TPM	0.35	<0.001	0.40

Relationship between Kaizen Practices and Efficiency Metrics

The correlation analysis presented in table 6, reveals strong negative relationships between Kaizen practices and inefficiency metrics, such as production cycle time ($r = -0.65$ for 5S and TPM) and defect rates ($r = -0.72$ for TQM). These results indicate that better implementation of 5S, TPM and TQM significantly improves operational efficiency. The

moderate correlation with equipment downtime (r = -0.60 for 5W1H) suggests these practices are also effective in addressing downtime issues.

Practice	Metric	Correlation (r)	p-value
5S	Production Cycle Time	-0.65	<0.01
TQM	Defect Rate	-0.72	<0.01
5W1H	Equipment Downtime	-0.6	<0.01
TPM	Production Cycle Time	-0.65	<0.01

Combined Effect of Kaizen Practices

Combining Kaizen practices, such as 5S with TQM and TPM, yields more improvement in production cycle time (35%). Table 7 indicates a synergetic effect when multiple Kaizen methods are integrated, reinforcing the importance of a holistic approach.

Practice Combination	Efficiency Metric Improved	Percentage of Improvement
5S + TQM + TPM	Production Cycle Time	35%
5S + 5W1H	Defect Rate	25%

4.3. Challenges to Implementation

Table 8 highlights the barriers to Kaizen implementation:

Challenge	Percentage of Respondents (%)
Inadequate Resources	58.3
Insufficient Training	50.0
Resistance to Change	41.7

Qualitative analysis indicated that these barriers were more pronounced in the maintenance department, where defect rates remained at 4% and downtime at 12%.

4.4. Discussion

The findings revealed that 5S, Total Quality Management (TQM), Total Productive Maintenance (TPM) and 5W1H are the primary Kaizen practices adopted at the steel factory, with 5S being the most widely utilized. High awareness and adoption of 5S practices (85%) align with global trends, as workplace organization is often the first step in implementing Kaizen due to its tangible effect on efficiency. The synergetic integration of multiple Kaizen tools, such as combining 5S with TPM, proved particularly effective in reducing downtime and improving workflow. Studies by Veres et al. (2022) in Romania and Makwana and Patange (2019) in India also highlight the prominence of 5S in streamlining operations and reducing waste. However, the relatively lower participation in problem-solving sessions (50%) and limited awareness of 5W1H (60%) suggest gaps in structured Kaizen training. This finding contrasts with the success reported in Japan, where systematic problem-solving methods like 5W1H are deeply embedded in organizational culture (Imai, 2022). The limited adoption of 5W1H at the steel factory may be attributed to resource constraints or inadequate emphasis during training. In Zambia, Chanda (2019) also noted that while 5S is commonly implemented, advanced Kaizen tools like 5W1H and Total Productive Maintenance (TPM) are less prevalent due to limited expertise and support. This emphasizes the need for more comprehensive Kaizen training programs tailored to developing economies.

The study highlighted notable improvements in operational efficiency metrics, including reductions in production cycle time (13.7%), defect rates (36%), and equipment downtime (30.6%) following Kaizen implementation. These results are consistent with global findings. For example, Liker (2020) reports that Kaizen practices, particularly 5S and TQM, have consistently enhanced production speed and reduced defects in manufacturing firms worldwide. Similarly, a study in Mexico by Hosono et al. (2020) demonstrated significant gains in operational metrics, including a 20% improvement in production times after adopting Kaizen.

Despite these improvements, inefficiencies persist in certain departments, particularly in quality assurance and maintenance, as evidenced by higher defect rates (4%) and significant equipment downtime (12%). This finding aligns with Todorovic and Cupic's (2019) study in Serbia, which noted that while Kaizen improves efficiency, sustaining gains requires robust cross-departmental collaboration and continuous monitoring. The findings underscore the effectiveness of Kaizen practices in enhancing operational efficiency. However, challenges such as resource constraints, insufficient training, and resistance to change impede full implementation.

5. Conclusion and Implications

This study demonstrates that Kaizen practices significantly enhance operational efficiency, particularly through the implementation of 5S, TQM, and TPM. These practices led to notable improvements in production cycle times, defect rates, equipment downtime, and operational costs. TQM and TPM had the most substantial effect, reflecting their robust applicability in addressing both technical and managerial aspects of operations. However, barriers such as inadequate resources, insufficient training, and resistance to change limited the full realization of these benefits.

Implications:

1. The study emphasizes the need for organizational commitment to foster a culture of continuous improvement.
2. A structured approach to Kaizen, supported by robust training and resource allocation, can drive significant operational gains.
3. Policymakers and industry stakeholders should promote Kaizen as a viable strategy for enhancing the manufacturing sector's competitiveness.

Recommendations:

1. Enhance Training Programs: Develop targeted training initiatives to ensure consistent application of Kaizen tools across all departments.
2. Foster Leadership Commitment: Encourage management to actively support and participate in Kaizen activities.
3. Allocate Adequate Resources: Provide the necessary financial, human, and material resources to sustain Kaizen practices.
4. Encourage Interdepartmental Collaboration: Share best practices and lessons learned among departments to improve overall efficiency.
5. Conduct Periodic Evaluations: Regularly monitor and evaluate the effectiveness of Kaizen practices to ensure continuous improvement.

Limitations of the Study

While this study provides valuable insights, it is not without limitations:

i. Sample Size and Scope: The research focused on a single steel manufacturing company, which may limit the generalizability of findings to other industries or regions.
ii. Cross-Sectional Design: Data collection was conducted at one point in time, preventing analysis of long-term effects of Kaizen practices.
iii. Self-Reported Data: Reliance on employee surveys introduces potential biases, such as social desirability bias, which could affect the accuracy of responses.
iv. Resource Constraints: Limited funding and time restricted the breadth of the study, particularly in terms of incorporating advanced technologies like real-time monitoring systems.
v. Cultural Context: The influence of organizational culture on Kaizen adoption was acknowledged but not deeply explored, leaving room for further investigation.

Future research should address these limitations by employing longitudinal designs, expanding the scope to include multiple companies, and integrating advanced technologies to better capture the dynamic effects of Kaizen practices.

Conflict of Interest

The authors declare that they have no conflicting interests

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Data Availability statement

The data used to support the findings of this study are available from the corresponding author upon request.

Ethical considerations

The article followed all ethical standards appropriate for this kind of research.

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