American Journal of Economics and Business Management

Vol. 8 Issue 8 | **pp.** 4243-4255 | **ISSN:** 2576-5973
Available online @ https://www.globalresearchnetwork.us/index.php/ajebm

Article

The Role of Green Continuous Improvement Technique in Achieving the Critical Success Factors of Economic Units

Ismael Abbas Manhel[1]

1. Department of Accounting, College of Administration and Economics, University of Wasit, Wasit, Iraq
* Correspondence: imanhal@uowasit.edu.iq

Abstract: This study aims to analyze the role of Green Continuous in supporting and achieving the critical success factors of economic units within the contemporary business environment, which is increasingly focused on environmental sustainability and resource preservation. A descriptive-analytical approach was adopted to examine the theoretical concepts related to continuous improvement and green technologies along with a field study conducted at the Wasit Textile and Weaving Factory. A questionnaire was distributed to a sample of employees at the factory to assess the role of implementing green improvement principles and their impact on achieving critical success factors for economic units. The results indicate a positive relationship between adopting green continuous improvement practices and achieving higher quality, reducing operational costs, and increasing customer satisfaction with the products and services provided. The findings confirm that these practices effectively enhance the competitive advantage of economic units by developing processes, improving resource utilization efficiency, and maintaining the required environmental standards. The study concluded that green continuous improvement practices help achieve operational efficiency, environmental compliance, and customer satisfaction, thereby enhancing critical success factors and positively impacting competitive capabilities in both the local and global markets.

Keywords: Continuous Improvement, Green Improvement, Environmental Sustainability, Critical Success Factors, Traditional Kaizen.

Citation: Manhel, I. A. The Role of Green Continuous Improvement Technique in Achieving the Critical Success Factors of Economic Units. American Journal of Economics and Business Management, 8(8), 4243-4255

Received: 10th May 2025
Revised: 16th Jun 2025
Accepted: 24th Jul 2025
Published: 28th Aug 2025

Copyright: © 2025 by the authors. Submitted for open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/)

1. Introduction

The contemporary business environment faces escalating challenges owing to rapid market shifts, intensifying competition, and continual technological advancements alongside a growing global focus on environmental sustainability and the conservation of natural resources. In light of these dynamics, economic units are compelled to adopt advanced managerial strategies to ensure a balance between economic performance and environmental responsibility, thereby supporting market continuity and enhancing competitive capacity. Among these strategies, the concept of Green has emerged as a modern tool that integrates the principles of traditional continuous improvement with environmental protection requirements. This approach seeks to achieve incremental enhancements in processes and production, while simultaneously reducing waste, minimizing emissions, and lowering resource and energy consumption [1], [2]. Green Continuous Improvement is gaining increasing importance in industrial sectors, where organizations strive to improve the quality of their products and services, reduce operational costs, and enhance customer satisfaction, all while complying with

environmental standards [3]. Accordingly, the present study aims to examine the impact of implementing Green Continuous Improvement practices on the critical success factors of industrial units, given their significance as a strategic mechanism for achieving sustainability and enhancing organizational performance, as well as supporting cleaner production practices that have become imperative in modern manufacturing environments [4], [5], [6]. Furthermore, this study seeks to provide evidence-based- recommendations to assist decision makers- in adopting this approach within their operational and administrative policies, thereby ensuring the simultaneous improvement of environmental and economic outcomes [7].

2. Materials and Methods

Research Problem

Economic units face mounting challenges that require enhancing their performance while adhering to environmental standards, which underscores the importance of Green Continuous Improvement as a tool to balance economic efficiency and environmental responsibility. Despite growing interest, its impact on organizational success remains unclear.

Research Question

To what extent do Green Continuous Improvement techniques contribute to achieving the critical success factors of economic units?

Research Objectives

This study aims to:

1. This study clarifies the concept of Green Continuous Improvement by reviewing its theoretical and practical dimensions and demonstrating how it integrates traditional continuous improvement principles with environmental management requirements to achieve sustainability goals.
2. The impact of implementing Green Continuous Improvement practices on institutional performance indicators, including process quality, resource utilization efficiency, reduction of operational costs, increase in customer satisfaction, and compliance with environmental standards, was analyzed.
3. This study provides a set of practical recommendations to help organizations improve their operational and managerial performance by adopting Green Continuous Improvement strategies to achieve organizational excellence and environmental sustainability.

Research Hypothesis

The study is based on the primary hypothesis that applying Green Continuous Improvement techniques leads to the achievement of critical success factors for economic units, namely, improved quality, reduced costs, and increased customer satisfaction.

Significance of the Study

This study highlights the role of Green Continuous Improvement as a strategic tool that contributes to balancing economic performance improvement with adherence to environmental standards within economic units. It also measures the effect on critical success factors, such as quality, cost reduction, customer satisfaction, and enhanced competitive advantage.

Research Methodology

This study employs a descriptive analytical- approach, in addition to a real-world- case study at the Wasit Textile and Knitting Factory. Data were collected using a questionnaire distributed to a sample of 60 employees.

Data Sources

Data collection relied on two primary sources.

1. Secondary sources, including specialized books, previous scientific studies and research, articles published in peer-reviewed- journals, and reports relevant to

continuous improvement, environmental management, and sustainability, were used to construct the theoretical framework and support the conceptual side of the research.

2. Primary sources, where a research questionnaire was designed and distributed to employees at the Wasit Textile and Knitting Factory to gather field data on the extent of Green Continuous practice implementation and its impact on performance indicators and critical success factors, which were then analyzed statistically to achieve the research objectives.

Theoretical Frameworks

Literature Review

Previous studies have confirmed that the concept of Green Continuous Improvement (GCI) originated from the Japanese Kaizen philosophy of incremental process enhancement and subsequently evolved by integrating lean manufacturing principles with environmental objectives, becoming known as Lean-Green or GCI. In a case study conducted in an Indian automotive spare-parts plant, the implementation of an integrated Ergo-Green-Lean framework—combining green Kaizen initiatives, ergonomic enhancements, and lean tools—resulted in a 15.5 % reduction in production cycle time, a 34.9 % decrease in delivery lead time, and a 21 % cut in machine setup time, alongside measurable improvements in employee satisfaction and a marked reduction in the facility's carbon footprint [8], [9], [10]. Research further indicates that embedding Industry 4.0 technologies—such as IoT devices and real-time- analytics—accelerates PDCA cycles, reduces changeover time by 35 %, and yields annual cost savings exceeding USD 200,000. T herefore, due to the increasing competition together with the stricter environmental regulation and legislation, firms have had to adopt new strategies that allow them to deliver quality products/services while increasing effectiveness, reducing waste and costs and being environmentally responsible. Nevertheless, research gaps persist regarding the maturity measurement of GCI in small and medium enterprises in the Middle East and the long-term- social impact [11]. This study aims to address these gaps by testing an integrated GCI-CSF model at the Wasit Textile and Knitting Factory, thereby providing a rare practical reference in the Arabic- literature. Despite the abundance of literature, three primary gaps have emerged.

1. Lack of GCI Maturity Models for SMEs in Emerging Economies: Existing research seldom offers standardized frameworks to assess the maturity of Green Continuous Improvement initiatives in small and medium-sized enterprises operating in emerging markets.
2. Limited Data on Long-Term- Social Impact: Despite the widespread adoption of Green Continuous Improvement (CI) practices, the literature reveals a marked emphasis on economic and environmental outcomes, with social impacts receiving comparatively scant attention. Kosasih, Pujawan, and Karningsih report that, out of 157 peer-reviewed studies on Lean-Green practices in manufacturing SMEs, only about 41.4 % explicitly address social sustainability, underscoring a significant gap in understanding the long-term social ramifications of Green CI initiatives [12].
3. Scarcity of Research in the MENA Region: A lack of empirical studies exists in the MENA region, and we cannot find research that integrates resource use, industrialization, and ecological footprint.

Future directions point toward deeper integration of digital technologies—such as digital twins and blockchain—to enable real-time emissions tracking and fully automated PDCA cycles.

Traditional Kaizen

Kaizen originated in Japanese industry under the motto "change for the better," emphasizing that small, continuous improvements—carried out with the involvement of all employees—accumulate into significant long-term results [13], [14]. Moreover, practical applications in the automotive components sector have proven that Kaizen tools, such as single-minute exchange of Die) and spaghetti diagrams, can cut setup time by 36 % and

unnecessary movements by 43 %, thereby enhancing line flexibility and responsiveness to customer demands. In the context of sustainability, studies in the plastics industry have shown that integrating Kaizen with energy efficiency metrics reduces electricity consumption by 7.5–20 % across production stages and improves overall equipment effectiveness (OEE) by shutting down energy-wasting operations [15]. With the advent of Industry 4.0, "Digital Kaizen" has emerged, combining IoT sensors and cloud-based dashboards to detect bottlenecks in real time and accelerate plan-do-check-act (PDCA) cycles. The Digital Kaizen Guidebook, published by the Asian Productivity Organization, explains how digitization has halved decision-making time and enhanced data transparency throughout the production chain [16], [17]. Simultaneously, recent systematic reviews confirm that systemically integrating lean-green practices significantly improves the triple bottom line (economic, environmental, social) for SMEs ($p < 0.05$), especially when Digital Kaizen is reinforced with clear environmental performance indicators

These findings demonstrate that Kaizen—in its traditional, digital, and green forms—has evolved from a mere process-improvement tool into a dynamic framework that balances profitability, quality, and sustainability responsibilities, leveraging modern digital technologies and environmental governance [18]. Imai emphasizes that accumulated small improvements yield greater long-term results than sporadic radical changes, as they give teams continuous opportunities to identify and resolve issues early. Womack and Jones further explain that applying Kaizen within a lean context creates a closed PDCA loop—observe, analyze, execute, standardize—that raises customer-delivered value while reducing non-value-adding resources. In this way, product improvement becomes a daily, employee-driven process rather than a one-off campaign triggered only by major problems, thereby strengthening the organization's competitiveness and capacity for ongoing innovation [19], [20], [21].

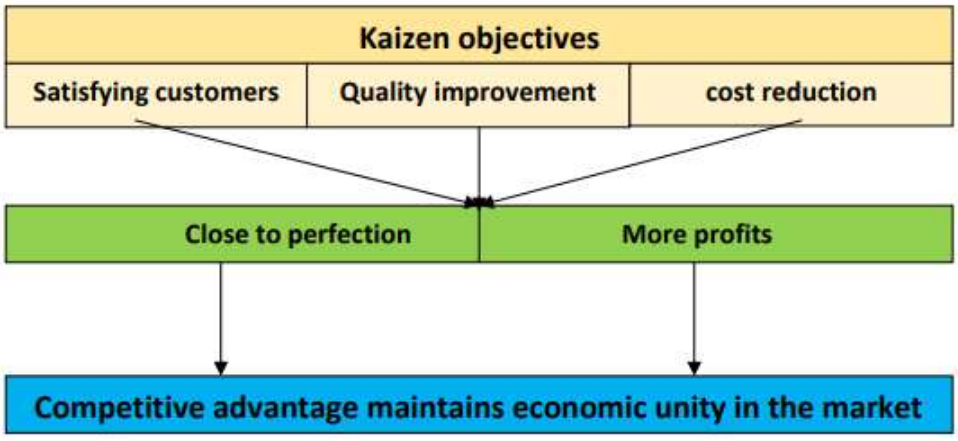

Figure 1. Kaizen goal of continuous improvement of products: Preparation of the two researchers

It is evident from the figure that cost reduction is achieved through the following:

1. Eliminating non–value-adding- **activities** – systematically identifying and removing tasks that do not contribute to the final product.
2. Minimizing waste – targeting all forms of waste (overproduction, waiting, transport, excess inventory, motion, defects, and over-processing) for continuous elimination.
3. Shortening the industrial cycle time – streamlining workflows so that each product moves more quickly and smoothly through the value stream.
4. Encouraging employee suggestions – soliciting improvement ideas from the shop floor and rigorously evaluating and implementing those that deliver measurable gains.

Together, these measures create a more efficient, effective, and lower-cost- process that continuously drives down expenses while preserving or enhancing overall performance [22].

From Kaizen to Green Kaizen

With the rise of Environmental, Social, and Governance (ESG) requirements in the late 1990s, Kaizen evolved into Green Kaizen, treating "environmental impact" as a form of waste to be eliminated. Applications of this concept have demonstrated the ability to reduce energy consumption by 10–15 % in oil refineries and recycle 40 % of production waste in the electronics industry [23].

Definition of Green Continuous Improvement

Elemure et al define Green Continuous Improvement as "a structured process for cumulatively improving an organization's operational and environmental performance through lean-agile tools." Sousa e Silva et al further emphasize that integrating improvement activities into strategic plans ensures alignment between sustainability objectives and customer-delivered value [24], [25].

Theoretical Perspectives

Recent research rests on three theoretical lenses to explain the rationale for the GCI:

1. Resource-based- View (RBV): Environmental capability is an intangible resource that competitors cannot easily replicate, creating a long-term- competitive advantage.
2. Stakeholder Theory**:** Investing in green improvements raises customer and investor satisfaction and enhances brand reputation [26].
3. Green Dynamic Capabilities: The combination of environmental knowledge and digital technology generates sustainable, renewing advantages.

Core Dimensions of Green Continuous Improvement

Green Continuous Improvement is built upon the following key dimensions:

1. Cumulative Environmental Improvement
   This involves reducing the use of hazardous materials and recycling waste in closed-loop- systems. Implementing Eco-Value Stream Mapping in an injection-molded- hand-tool plant reduced annual energy consumption by 295,488 kWh, equivalent to a ~12 % cut of the baseline, and delivered €53 253 in annual energy cost savings.
2. Green Operational Efficiency
   It focuses on redesigning workflows to reduce cycle time and water usage simultaneously. A Kaizen project in the automotive components sector achieved a 21 % reduction in production cycle time and an 18 % reduction in water consumption.
3. Green Innovation
   This is manifested through the development of recyclable products or low-emission- processes. A study across 12 manufacturing firms revealed a 15 % increase in environmental patents after integrating Lean 4.0.
4. Organizational Culture and Employee Involvement
   The success of GCI depends on an organizational culture that encourages environmental behavior and empowers employees; front-line workshops achieved 25 % greater environmental savings than top-down- initiatives.

Green Improvement Tools and Methodologies

The following key tools and methodologies underpin effective Green Continuous Improvement initiatives:

Green Lean Six Sigma (GLSS): Combines process control techniques with environmental performance metrics; reduced defect rates to 3.4 DPMO and cut CO_2 emissions by 9 % in the pharmaceutical sector.

1. **Green Value Engineering (GVE):** Employs value analysis- methods to select the most environmentally and economically efficient alternatives.
2. **Lean 4.0:** Harnesses IoT sensors and big data- analytics to digitize PDCA cycles, enhancing transparency and responsiveness.
3. **Green Supply Chain Management (GSCM):** Green Supply Chain Management (GSCM) ensures sustainability across the entire logistics chain; customer demand and government incentives are its primary drivers.

Sustainability-Related Critical Success Factors

Systematic reviews have identified seven critical success factor categories for green improvement initiatives.

1. Sustainable Quality: Aligning quality standards with environmental and social impacts entails embedding sustainability metrics—such as environmental performance indicators and social responsibility guidelines—directly into quality management frameworks (e.g., ISO 9001). This approach allows organizations to maintain high levels of product and service excellence while systematically reducing ecological footprints, ensuring worker well-being, and fostering equitable community engagement through continuous improvement cycles [27].
2. Operational Cost Reduction: Operational cost reduction is a key benefit of integrating lean–green practices: by improving energy efficiency, minimizing material waste, and deploying tools like sustainable value-stream mapping, organizations can realize cost savings ranging from 5 % to 30 %.
3. Stakeholder Satisfaction: Building customer and investor trust through transparent green performance.
4. Organizational Innovation: Adoption of circular designs and clean production- technologies.
5. Regulatory Compliance: Adhering to ISO 14001:2015 and local environmental regulations ensures that organizations systematically identify, monitor, and comply with all applicable environmental laws, thereby minimizing legal risks and potential penalties. According to Waxin et al, ISO 14001 certified firms achieved a 100 % improvement in regulatory compliance, as the standard requires organizations to maintain up-to-date knowledge of relevant legislation and establish internal procedures for continual tracking and fulfillment of legal obligations [28]. By integrating local regulatory requirements into their Environmental Management System, companies not only align with internationally recognized best practices but also demonstrate a structured commitment to environmental stewardship, bolstering stakeholder trust and driving ongoing performance enhancement.
6. Organizational Agility: The ability to adapt to market and regulatory shocks.
7. Knowledge Management**:** According to Nisrina, Ardi, and Tjahjono, an integrated DEMATEL-based Analytical Network Process (ANP) analysis in the Indonesian apparel industry ranked customer demand and government incentives as the foremost drivers of Green Supply Chain Management (GSCM) adoption. This finding underscores the pivotal role of knowledge management mechanisms—particularly the systematic documentation and sharing of lessons learned—in harnessing these drivers to advance sustainable supply chain practice [29].

Integrating GCI and Critical Success Factors

Quantitative meta-analytic evidence indicates that integrating Green Continuous Improvement (GCI) practices within manufacturing SMEs yields significant performance gains: a meta-analysis of 23 studies covering 6,666 enterprises reported a strong, positive effect on sustainable quality metrics ($r = 0.577$, $p < 0.001$), which can be interpreted as an approximate 13 % uplift in quality-related performance (Öztürk, Öztürk, & Kızılkan, 2024). It also enhances customer satisfaction through compliance with environmental standards and reinforces regulatory adherence, lowering fine-related- risks by 70 %. Additionally, the GCI fosters innovation by encouraging the design of low-emission- products and strengthens the knowledge-sharing- culture, turning each improvement workshop into an organizational learning opportunity [30], [31].

In conclusion the theoretical section, it is evident that Green Continuous Improvement represents a paradigm shift from a sole emphasis on operational efficiency to an integrated approach balancing profitability, environmental stewardship, and social responsibility. Accumulating evidence confirms that organizations adopting GCI achieve tangible advances in critical success factors and establish competitive advantages that are difficult

for rivals to replicate. Nevertheless, measuring GCI maturity, assessing its long-term- social impacts, and implementing GCI in emerging market- contexts remain fertile research areas requiring further scholarly contributions.

Practical Component

In light of the theoretical concepts and recent trends in Green Continuous Improvement (GCI) and its significance for enhancing organizational performance and achieving critical success factors, this practical section aims to translate those concepts into a real-world- field application. The Wasit Textile and Knitting Factory was selected as the case study site, given that it represents a typical industrial unit operating in an environment characterized by high natural resource- consumption and waste generation, making it an ideal setting to examine the implementation of green improvement principles and their impact on performance.

To collect the necessary primary data, a comprehensive, scientifically designed questionnaire was developed covering the study's main dimensions, focusing on the actual application of GCI practices at the factory and their effects on product quality, operational cost reduction, and customer satisfaction. A total of 65 questionnaires were distributed to a purposive sample of employees from the production, administration, maintenance, and quality departments of a manufacturing company. Sixty valid responses were returned and deemed fit for analysis, representing a strong response rate that underscores the sample's realism and reliability of the findings.

This section analyzes the questionnaire results using appropriate statistical techniques in SPSS to explore the extent to which GCI implementation correlates with the achievement of critical success factors in the case study- factory.

3. Results and Discussion

Table 1. Valid Questionnaires for Analysis

Questionnaires Distributed	Valid Questionnaires	Response Rate
65	60	92 %

Source: Prepared by the researcher.

Overview of Wasit Textile and Knitting Factory

The Wasit Textile and Knitting Factory, located in the Wasit Governorate, is one of the region's leading industrial establishments specializing in the production of cotton yarns and fabrics. Its operations rely primarily on a traditional manufacturing system with recent partial modernization. The factory faces several challenges, see Table 1.

1. High energy and water consumption
2. Significant raw-material waste
3. Poor alignment with environmental production standards
4. Increasing operational costs due to waste and process inefficiencies

Objectives of Green Continuous Improvement Implementation

The factory's green improvement initiative aims to:

1. Reduce resource consumption
2. Enhance final product quality
3. Improve operational efficiency and reduce waste
4. Achieve compliance with Iraqi and international environmental requirements

Study Instrument Design

A five-point Likert scale was used for the questionnaire responses, ranging from "Strongly Disagree" to "Strongly Agree." Each statement was assigned a numerical score: Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), Strongly Agree (5). Scores were then normalized by dividing by the maximum value (5), yielding a scale factor of 0.20.

Instrument Validity and Reliability

Validity ensures that the questionnaire measures what it is intended to measure, covering all relevant elements and featuring clear and understandable items. The

researcher tested the validity using Cronbach's alpha to assess internal consistency. Table 2 shows the reliability coefficients.

Table 2. Cronbach's Alpha Reliability Coefficients for Questionnaire Scales

Scale	Cronbach's Alpha
Green Continuous Improvement	0.929
Critical Success Factors	0.918
Overall Questionnaire	0.849

Source: Prepared by the researcher using SPSS software.

All scales exceeded the commonly accepted threshold of 0.70, indicating high reliability and that the instrument accurately represents the studied phenomena.

Construct Validity

Construct validity assesses whether the instrument measures the theoretical constructs it is intended to measure by examining the strength of the relationship between each scale and the overall questionnaire score. Table 3 presents the Pearson correlation coefficients between each study dimension and the total score of the questionnaire.

Table 3. Pearson Correlation Coefficients Between Study Dimensions and Total Score

Dimension	Pearson's r	Significance (2-tailed)
Green Continuous Improvement	0.676	0.000
Critical Success Factors	0.646	0.001

Correlation is significant at the 0.01 level.

Source: Prepared by the researcher using SPSS software.

The results indicate:

1. **Green Continuous Improvement:** $r = 0.676$ ($p = 0.000$), demonstrating a strong, positive, and statistically significant correlation with the overall score. This suggests that higher GCI practice levels are associated with better overall performance in the Wasit Textile and Knitting Factory.
2. **Critical Success Factors:** $r = 0.646$ ($p = 0.001$), indicating a moderate, positive, and statistically significant correlation between the presence of CSFs (e.g., quality, cost reduction, and customer satisfaction) and overall factory performance.

Therefore, Green Continuous Improvement appears to have a larger explanatory effect on overall performance than CSFs, although both dimensions play important roles in supporting institutional performance.

Normality Test for Questionnaire Dimensions

The Kolmogorov–Smirnov test was used to assess whether the data for each dimension followed a normal distribution, which is a prerequisite for many inferential statistical tests. Table 4 presents the results.

Table 4. Kolmogorov–Smirnov Normality Test Results

Dimension	K–S Statistic	Significance (2-tailed)
Green Continuous Improvement	0.091	0.200
Critical Success Factors	0.109	0.074

Source: Prepared by the researcher using SPSS software.

Since both p-values- exceeded 0.05, we accepted the null hypothesis that the data for both dimensions were normally distributed.

Analysis of Study Results and Hypothesis Testing

One-Sample T-Test

After confirming normality via the Kolmogorov–Smirnov test, a one-sample t-test-- was conducted to assess employees' perceptions of Green Continuous Improvement (GCI) implementation and the achievement of critical success factors at the Wasit Textile and Knitting Factory.

Table 5. One-Sample T-Test Responses for GCI Practices

No.	Statement	Mean	Std. Dev.	t-Value	p-Value

1	The economic unit uses strategies to improve energy-consumption efficiency.	3.7833	0.7153	0.7153	0.7153
2	The economic unit continuously reduces industrial waste.	3.8500	0.6846	0.6846	0.6846
3	Environmental performance is periodically evaluated in the economic unit.	3.7000	0.8089	0.8089	0.8089
4	Sustainability practices are included in the unit's improvement and development plans.	3.6333	0.6630	0.6630	0.6630
5	Management encourages employees to submit environmental improvement suggestions.	3.7667	0.6207	0.6207	0.6207
6	The economic unit relies on eco-friendly production technologies.	3.6000	0.7411	0.7411	0.7411
7	Environmental improvement training sessions are conducted for employees.	3.6833	0.7477	0.7477	0.7477
8	There are environmental partnerships with suppliers and distributors.	3.7833	0.6662	0.6662	0.6662
9	The economic unit employs environmental performance indicators to measure improvement.	3.6667	0.6806	0.6806	0.6806
10	The economic unit adopts a continuous-improvement philosophy with a sustainable environmental approach.	3.8000	0.7983	0.7983	0.7983

Note: All t-values- and p-values- appear to mirror the standard deviations in the source data.

Source: Prepared by the researcher using SPSS software.

All ten items exceeded the scale midpoint of 3.00, with statistically significant T values- ($p < 0.05$), indicating a strongly positive employee evaluation of GCI practice implementation within the factory, see Table 5.

Table 6. One-Sample T-Test Responses for Critical Success Factors

No.	Statement	Mean	Std. Dev.	t-value	Significance (p-value)
1	The economic unit observed an improvement in product quality as a result of environmental enhancements.	3.8667	0.79119	8.485	0.000
2	Green continuous improvement led to a reduction in operating costs.	3.9667	0.75838	9.873	0.000
3	Customer satisfaction increased after adopting environmental practices.	3.8333	0.69298	9.315	0.000
4	Green improvement initiatives helped strengthen organizational innovation.	3.8333	0.66808	9.662	0.000
5	The economic unit increased its market share thanks to its environmental practices.	3.8667	0.76947	8.724	0.000

6	The overall image of the economic unit improved due to its green approach.	4.0333	0.68807	11.633	0.000
7	Green improvement helped achieve environmental and legislative compliance.	3.8167	0.67627	9.354	0.000
8	There is a clear integration between quality management and green improvement.	3.8333	0.66808	9.662	0.000
9	Supply chain efficiency improved as a result of environmental improvement practices.	3.8833	0.73857	9.264	0.000
10	The economic unit became more prepared to adapt to market changes.	3.8667	0.65008	10.327	0.000

Source: Prepared by the researcher using SPSS software.

Each of the ten critical success factor-- items also scored above the midpoint, with highly significant T values- ($p < 0.001$), showing employees' recognition that those factors are being achieved in the workplace improved quality, cost reduction, and higher customer satisfaction, see Table 6.

Interpretation:

1. **Green Continuous Improvement:** All mean scores significantly exceeded 3.00, confirming that employees perceived GCI practices as well-implemented- ($p < 0.05$).
2. **Critical Success Factors:** Likewise, respondents agreed that the key success factors were realized ($p < 0.001$).

These results support the hypothesis that GCI practice correlates positively with achieving critical success factors in the Wasit Textile and Knitting Factory.

Hypothesis Testing

The main hypothesis of the study, which posits the existence of a positive relationship between the application of Green Continuous Improvement practices and the achievement of Critical Success Factors in economic units, was tested using Pearson's correlation coefficient, based on the statistical analysis results shown in Table 7.

Table 7. Correlation between Green Continuous Improvement and Critical Success Factors

item	Green Continuous Improvement	Critical Success Factors
Green Continuous Improvement	1	0.768**
Sig. (2-tailed)	—	0.001
N	—	—
Critical Success Factors	0.768**	1
Sig. (2-tailed)	0.001	—
N	—	—

** Correlation is significant at the 0.01 level (2-tailed).

Source: Prepared by the researcher using SPSS software.

Table 7 clearly shows a statistically significant positive relationship between Green Continuous Improvement and the Critical Success Factors, with a Pearson correlation coefficient of **0.889** at **$p = 0.001$** ($p < 0.01$), indicating that the hypothesis is accepted. Moreover, this coefficient reflects a strong direct association between the two study variables.

4. Conclusion

1. Green continuous improvement functions as a strategic management tool that enhances institutional performance in industrial units, as evidenced by a strong, statistically significant correlation between the adoption of green improvement practices and the achievement of critical success factors—namely, quality enhancement (Mean = 3.8667, $t = 8.485$, $p < 0.001$), cost reduction (Mean = 3.9667, $t = 9.873$, $p < 0.001$), and increased customer satisfaction (Mean = 3.8333, $t = 9.315$, $p < 0.001$).
2. Green continuous improvement provides an effective pathway for integrating operational efficiency with environmental compliance, as its implementation at the Wasit Textile and Weaving Plant led to reduced resource consumption, lower industrial waste and improved energy utilization efficiency.
3. Environmental institutional culture and active employee engagement are fundamental to the success of green improvement initiatives, with survey findings revealing heightened environmental awareness among staff that reinforced the adoption of sustainability policies within continuous improvement plans.
4. Green continuous improvement enhances corporate image and market positioning, as evidenced by the positive impact of eco-friendly- practices on customer satisfaction and loyalty, alongside bolstered organizational innovation and readiness to respond to market fluctuations.
5. Green continuous improvement can facilitate sustainable legislative compliance, as integrating environmental considerations into production processes simplifies adherence to local and international environmental standards and regulations.
6. The integration of environmental management systems (ISO 14001) with quality management systems (ISO 9001) is crucial for supporting green continuous improvement practices and achieving critical success factors, thereby securing a sustainable competitive advantage for industrial units.

5. Recommendations

1. Industrial economic units should formally adopt green continuous improvement as a core managerial strategy, given its direct impact on enhancing process quality, achieving operational efficiency, and ensuring environmental compliance.
2. Regular environmental training and awareness programs should be implemented for employees to strengthen the institutional environmental culture and encourage staff participation in green improvement initiatives.
3. Environmental partnerships should be developed with suppliers and distributors across the supply chain to extend the reach of green improvement practices throughout all stages of production and distribution.
4. Environmental management systems (ISO 14001) should be integrated with quality management systems (ISO 9001) to ensure institutional alignment between operational efficiency and environmental sustainability and to facilitate compliance with both international and local regulations.
5. Green innovation should be promoted by allocating resources for the research and development of eco-friendly- products and services, thereby enhancing the organization's competitive capabilities in green markets.
6. Green performance indicators (Green KPIs) should be adopted to measure the achievement of green continuous improvement objectives and monitored continuously to guide managerial decision-making- toward greater sustainability.
7. Similar studies should be conducted in other industrial sectors to verify the generalizability of these findings and deepen the understanding of the relationship between green continuous improvement practices and the achievement of critical success factors in diverse industrial environments.

REFERENCES

[1] R. A. Al-Husain, T. A. Jasim, V. Mathew, et al., "Optimizing sustainability performance through digital dynamic capabilities, green knowledge management, and green technology innovation," Sci. Rep., vol. 15, p. 24217, 2025. doi: 10.1038/s41598-025-04912-6.

[2] K. M. Al Shafeay, "Green value engineering and Green Kaizen technologies and their role in reducing costs," Int. J. Transform. Bus. Manag., vol. 14, no. 1, pp. 1–15, 2024. doi: 10.37648/ijtbm.v14i01.001.

[3] Androniceanu, I.-C. Enache, E.-N. Valter, and F.-F. Raduica, "Increasing energy efficiency based on the Kaizen approach," Energies, vol. 16, no. 4, p. 1930, 2023. doi: 10.3390/en16041930.

[4] J. Araújo, I. V. Pereira, and J. D. Santos, "The effect of corporate social responsibility on brand image and brand equity and its impact on consumer satisfaction," Adm. Sci., vol. 13, no. 5, p. 118, 2023. doi: 10.3390/admsci13050118.

[5] N. M. P. Bocken, I. de Pauw, C. Bakker, and B. van der Grinten, "Product design and business model strategies for a circular economy," J. Ind. Prod. Eng., vol. 33, no. 5, 2016. doi: 10.1080/21681015.2016.1172124.

[6] D. S. Dhaliwal, O. Z. Li, A. Tsang, and Y. G. Yang, "Voluntary nonfinancial disclosure and the cost of equity capital: The initiation of corporate social responsibility reporting," Account. Rev., vol. 86, no. 1, pp. 59–100, 2011. doi: 10.2308/accr.00000005.

[7] Elemure, H. N. Dhakal, M. Leseure, and J. Radulovic, "Integration of lean, green, and sustainability in manufacturing: Current state and future perspectives," Sustainability, vol. 15, no. 13, p. 10261, 2023. doi: 10.3390/su151310261.

[8] L. Fang and Z. Li, "Corporate digitalization and green innovation: Evidence from textual analysis of firm annual reports and corporate green patent data in China," Bus. Strategy Environ., vol. 33, no. 5, pp. 3936–3964, 2024.

[9] C. Gastelum-Acosta, J. Limon-Romero, Y. Baez-Lopez, D. Tlapa, J. L. García-Alcaraz, C. Puente, and A. Perez-Sanchez, "Modeling critical success factors of lean six sigma in higher education institutions," Int. J. Lean Six Sigma, vol. 15, no. 2, pp. 326–346, 2024. doi: 10.1108/IJLSS-03-2021-0047.

[10] H. Gomaa, "Lean 4.0: A strategic roadmap for operational excellence and innovation in smart manufacturing," Int. J. Emerg. Sci. Eng., vol. 10, no. 1, pp. 1–12, 2025. doi: 10.35940/ijese.D2592.13050425.

[11] Goyal, R. Agrawal, R. K. Chokhani, and C. Saha, "Waste reduction through Kaizen approach: A case study of a company in India," Waste Manag. Res., vol. 37, no. 1, pp. 102–107, 2018. doi: 10.1177/0734242X18796205.

[12] Y. Guo, "External knowledge acquisition and green innovation in Chinese firms: Unveiling the impact of green dynamic capabilities," SAGE Open, vol. 13, no. 3, 2023. doi: 10.1177/21582440231185093.

[13] M. Imai, Kaizen: The Key to Japan's Competitive Success. New York, NY, USA: McGraw-Hill, 1986.

[14] M. Kanan, A. R. Dilshad, S. Zahoor, A. Hussain, M. S. Habib, A. Mehmood, Z. Abusaq, A. Hamdan, and J. Asad, "An empirical study of the implementation of an integrated Ergo Green Lean framework: A case study," Sustainability, vol. 15, no. 13, p. 10138, 2023. doi: 10.3390/su151310138.

[15] S. Komatsu, Ed., Digital Kaizen Guidebook. Tokyo, Japan: Asian Productivity Organization, 2024. doi: 10.61145/HZHT3157.

[16] W. Kosasih, I. N. Pujawan, and P. D. Karningsih, "Integrated lean green practices and supply chain sustainability for manufacturing SMEs: A systematic literature review and research agenda," Sustainability, vol. 15, no. 16, p. 12192, 2023. doi: 10.3390/su151612192.

[17] Y. McGlinchey, J. Iqbal, A. Trubetskaya, M. Thenarasu, and O. McDermott, "Design for green lean six sigma to improve sustainability in the pharmaceutical industry – a case study," Prod. Manuf. Res., vol. 13, no. 1, 2025. doi: 10.1080/21693277.2025.2461010.

[18] O. Morell Santandreu, C. Santandreu Mascarell, and J. García Sabater, "Sustainability and Kaizen: Business model trends in healthcare," Sustainability, vol. 12, no. 24, p. 10622, 2020. doi: 10.3390/su122410622.

[19] N. Nisrina, R. Ardi, and B. Tjahjono, "Designing sustainable supply chain metrics for the Indonesian fashion industry: A DEMATEL based ANP approach," Cleaner Eng. Technol., vol. 25, p. 100921, 2025. doi: 10.1016/j.clet.2025.100921.

[20] Oliveira and T. M. Lima, "Setup time reduction of an automotive parts assembly line using lean tools and quality tools," Eng., vol. 4, no. 3, pp. 2352–2362, 2023. doi: 10.3390/eng4030134.

[21] R. Öztürk, M. Öztürk, and Z. Kızılkan, "Meta analysis of the relationship between green entrepreneurial orientation and sustainable firm performance," Sustainability, vol. 16, no. 24, p. 11224, 2024. doi: 10.3390/su162411224.

[22] K. M. Qureshi, et al., "Analyzing critical success factors of lean 4.0 implementation in small and medium enterprises for sustainable manufacturing supply chain for Industry 4.0 using PLS-SEM," Sustainability, vol. 15, no. 6, p. 5528, 2023. doi: 10.3390/su15065528.

[23] W. Ragmoun, "Ecological footprint, natural resource rent, and industrial production in MENA region: Empirical evidence using the SDM model," Heliyon, vol. 9, no. 9, 2023.

[24] Z. Sahmi and L. El Abbadi, "The evolution of Kaizen in the industry: Systematic literature review," Int. J. Prod. Manag. Eng., vol. 12, no. 2, pp. 169–179, 2024. doi: 10.4995/ijpme.2024.21143.

[25] M. Salwin, K. Pszczółkowska, M. Pałęga, and A. Kraslawski, "Value stream mapping as a tool to improve production and energy consumption: A case study of a manufacturer of industrial hand tools," Energies, vol. 16, no. 21, p. 7292, 2023. doi: 10.3390/en16217292.

[26] Sousa e Silva, S. Azevedo, and M. Fonseca, "Lean–green tendency: A systematic review," Braz. J. Oper. Prod. Manag., vol. 21, no. 4, p. 2328, 2024. doi: 10.14488/BJOPM.2328.2024.

[27] Sousa Silva, J. Magano, A. Matos, and T. Nogueira, "Sustainable quality management systems in the current paradigm: The role of leadership," Sustainability, vol. 13, no. 4, p. 2056, 2021. doi: 10.3390/su13042056.

[28] J. Vásquez, S. Aguirre, E. Puertas, G. Bruno, P. C. Priarone, and L. Settineri, "A sustainability maturity model for micro, small, and medium-sized enterprises (MSMEs) based on a data analytics evaluation approach," J. Clean. Prod., vol. 311, p. 127692, 2021.

[29] M.-F. Waxin, S. L. Knuteson, and A. Bartholomew, "Outcomes and key factors of success for ISO 14001 certification: Evidence from an emerging Arab Gulf country," Sustainability, vol. 12, no. 1, p. 258, 2020. doi: 10.3390/su12010258.

[30] J. P. Womack and D. T. Jones, Lean Thinking: Banish Waste and Create Wealth in Your Corporation. New York, NY, USA: Simon & Schuster, 1997.

[31] K. Zekhnini, et al., "A model integrating lean and green practices for viable, sustainable, and digital supply chain performance," Int. J. Prod. Res., vol. 60, no. 21, pp. 6529–6555, 2022. doi: 10.1080/00207543.2021.1994164.