Integration of Total Quality Management and Green Practices as a Driver of Sustainable Development: A Pilot Study of Manufacturing Companies in the Republic of North Macedonia

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***Abstract* – In the context of increasing global and local demands for sustainability, this study investigates the impact of integrating total quality management (TQM) with green practices on organizational performance in manufacturing companies in the Republic of North Macedonia. The research is based on a pilot study conducted in six companies and employs a mixed-methods approach, combining surveys, analysis of key performance indicators (KPIs), and in-depth case studies. The findings demonstrate that the integrated TQM and green practices model leads to a significant 58% reduction in defects and an 11% increase in productivity compared to the TQM-only group. Moreover, the results highlight the model's applicability and effectiveness in small-scale economies, suggesting that a strategic alignment of quality management with environmental practices can create both operational efficiencies and sustainable competitive advantages. This study contributes to the understanding of how combined management and sustainability initiatives can support organizational performance in emerging markets.**

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1. Introduction

Contemporary organizations operate in an environment of intense economic, technological, and social changes, which significantly transform traditional management models. Beyond classical objectives related to quality, efficiency, and competitiveness, companies increasingly face growing demands for sustainability, environmental responsibility, and socially responsible behavior [1], [2]. These demands arise both from stricter regulatory frameworks and from increased awareness among consumers, investors, and the broader public regarding the impact of business activities on the environment and society.

Total quality management (TQM) is one of the most influential and widely adopted management systems, developed in response to the need for systematic and continuous improvement of organizational performance. TQM is defined as a holistic managerial approach aimed at long-term success through customer satisfaction and the involvement of all organizational members in improvement processes [3], [4]. TQM is based on several key principles, including customer orientation, continuous improvement, process-based management, fact-based decision-making, and active employee participation [5].

Research shows that TQM implementation contributes to improved product and service quality, reduced operational costs, increased productivity, and strengthened competitive positioning [6], [7]. However, the traditional focus of TQM has been mainly on economic and operational performance, while environmental and social aspects have long remained peripheral in management systems.

Over the past two decades, with the growing importance of sustainable development, there has been increasing interest in linking TQM with green practices and the broader environmental, social, and governance (ESG) framework. Green practices encompass a wide range of activities aimed at reducing negative environmental impacts, including energy efficiency, waste management, emission reduction, and eco-innovation [8], [9]. The ESG approach further expands the focus to social and governance aspects, such as employee relations, transparency, and ethical corporate governance [10].

Several studies suggest that TQM principles provide a suitable foundation for implementing green practices, as continuous improvement, process control, and employee involvement enable systematic management of environmental aspects of operations [11], [12]. Integration of TQM with green practices can result in synergistic effects, enabling companies to simultaneously improve environmental, economic, and social performance [13].

Despite the growing number of international studies, empirical research analyzing the integration of TQM and ESG practices in developing countries and small economies remains limited. Most studies focus on developed economies, where higher levels of technological maturity and institutional support exist [14], [15]. In this context, the applicability and effectiveness of the integrated TQM + ESG approach in countries such as the Republic of North Macedonia remain underexplored.

Macedonian manufacturing companies face specific challenges, including limited financial resources, lack of expertise, and a variable regulatory environment, which may affect their readiness to implement advanced management and environmental systems. Therefore, there is a clear need for empirical research to examine how these companies apply TQM practices, the extent to which they integrate green and ESG initiatives, and the resulting effects on organizational efficiency and competitiveness.

The aim of this study is to address this research gap through a pilot investigation conducted in Macedonian manufacturing companies. The research focuses on analyzing the extent of application of classical TQM practices and green (environmental) practices, their interconnection, and their combined impact on organizational performance. Furthermore, the study aims to identify key barriers and critical success factors for the effective implementation of an integrated TQM + ESG system, with the goal of proposing guidelines for developing a model adapted to the local context.

2. Literature Review

TQM represents a holistic management system that focuses on continuous improvement of all organizational processes and the involvement of all members of the organization in quality management [5], [6]. The core principles of TQM include quality-oriented leadership, active employee involvement, process control and standardization of work procedures, as well as continuous monitoring and performance improvement [3], [4]. In the modern context, TQM not only enhances organizational efficiency and productivity but also provides a systematic foundation for integrating other sustainable development strategies [7], [11].

Green practices are aimed at resource optimization, waste reduction, energy efficiency, rational use of raw materials, and socially responsible environmental management [8], [9]. Integrating these practices into organizational processes allows companies to reduce the environmental impact of their operations while simultaneously improving their economic and social performance. The ESG framework (environmental, social, and governance) further expands the focus to social and governance aspects of business operations, including transparency, ethical corporate governance, and employee relations, thereby enhancing corporate reputation and long-term sustainability [10], [13].

Increasingly, research indicates that integrating TQM with green practices and ESG components creates significant synergies. Companies applying this combined approach often achieve higher productivity, fewer errors and defects, improved process efficiency, and simultaneous enhancement of environmental and social responsibility [11], [14], [15]. Conceptual models developed in the international literature suggest that the integrated TQM + green practices approach can improve organizational competitiveness and enable long-term sustainable development, especially when all organizational levels are involved and a systematic process of continuous improvement is followed [7], [16], [17].

It is emphasized that business process optimization is a prerequisite for sustainability in emerging markets.

Contemporary organizations operate in an environment of intense economic, technological, and social changes, which significantly transform traditional management models [18], [19].

The core principles of TQM include quality-oriented leadership, active employee involvement, and continuous monitoring of processes [3], [20].

The ESG framework further expands the focus to social and governance aspects, enhancing corporate reputation and long-term sustainability [10], [21].

In the Macedonian context, however, the number of companies formally integrating TQM and ESG practices remains limited. Research shows that local conditions, such as limited financial and human resources, specific organizational culture, and insufficient institutional support, affect the successful implementation of integrated management systems [17]. It is contended that integrating ESG via TQM enables companies to overcome limitations related to financial and institutional resources. It is necessary to explore the specific mechanisms and challenges faced by Macedonian companies in integrating TQM and green practices, as well as to determine their impact on organizational efficiency, competitiveness, and sustainable development.

The literature review indicates that there is significant theoretical and practical potential in combining TQM and ESG/green practices, yet localized empirical studies are lacking that would adapt international concepts to the reality of Macedonian manufacturing companies. This gap highlights the need for research that provides data on the degree of integration, implementation challenges, and impact on organizational outcomes, in order to develop an adapted model applicable to the Macedonian context.

3. Research Methodology

The aim of this study is to investigate the integration of total quality management (TQM) and green (environmental) practices in Macedonian manufacturing companies, focusing on their impact on organizational effectiveness, competitiveness, and corporate reputation. To achieve this objective, the following research questions were formulated: How do TQM practices influence the implementation of green practices? Do combined TQM + green practices contribute to improved organizational outcomes?, and What are the main barriers to implementing such a “hybrid” system in the Macedonian context?

3.1. Research Design and Justification of the Mixed Methods Approach

This research employs a mixed methods approach to provide a comprehensive analysis of the integration of TQM and green practices in Macedonian manufacturing companies (Figure 1). Figure 1 illustrates the sequential explanatory design used in this study, where quantitative KPI analysis is complemented by qualitative case studies to provide a holistic view of TQM and green practice integration.

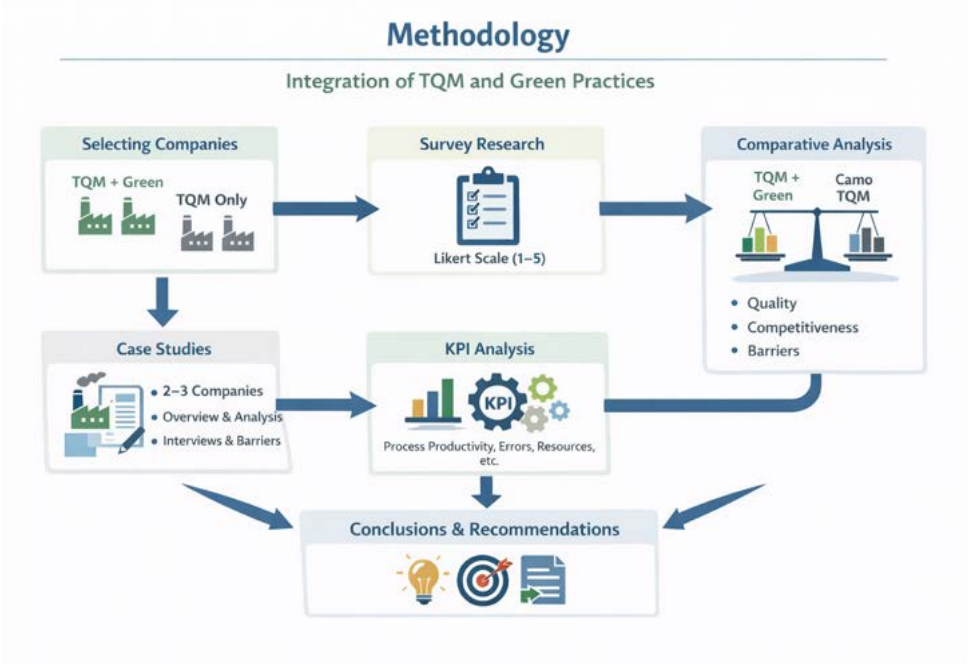

Figure 1. Mixed methods research approach integrating quantitative and qualitative methods

This approach enables a clear and traceable understanding of the effectiveness and applicability of the integrated model, as well as recommendations for its adaptation to the Macedonian context.

The combination of quantitative and qualitative methods is justified by the complex and multidimensional nature of sustainable management systems, where quantitative indicators alone are insufficient to fully explain organizational processes and outcomes.

The quantitative component allows objective measurement of organizational performance through key performance indicators (KPIs), while the qualitative component provides deeper insights into organizational culture, managerial decisions, institutional constraints, and barriers to implementing the integrated TQM + green practices model.

The study follows an explanatory sequential mixed methods design, in which:

- quantitative data (surveys and KPIs) are analyzed first,
- qualitative data (case studies, interviews, and document analysis) are then used to explain and interpret the quantitative results.

This design is particularly suitable for pilot studies and research contexts where the aim is analytical rather than statistical generalization, which is typical for small economies and developing countries.

3.2. Sample Selection and Justification of Purposive Sampling

The study was conducted in six manufacturing companies in North Macedonia, divided into two groups:

- three companies with an established TQM system,
- three companies with an integrated TQM and green practices system.

The companies were selected using purposive sampling, which is methodologically justified due to the pilot nature of the study and the need to select informative and relevant cases. This methodological choice is consistent with pilot studies in developing economies where depth of information is prioritized over statistical breadth [18], [20].

This approach was chosen instead of random sampling for the following reasons:

- Inclusion of companies with documented TQM implementation,
- Guaranteed access to relevant KPIs and internal documentation,
- Possibility for comparative analysis between different levels of integration,
- Focus on in-depth understanding rather than representativeness.

In research on quality and sustainability, purposive sampling is widely accepted when the goal is to identify mechanisms, practices, and contextual factors, especially in resource-constrained economies.

3.3. Data Collection Methods

Data were collected using methodological triangulation, including:

- Survey Questionnaire:

Surveys were conducted among management and employees using a Likert scale (1–5) to measure perceptions regarding:

- implementation of TQM practices,
- implementation of green practices,
- organizational performance,
- employee satisfaction,
- identified barriers.

- Case Studies and Interviews:

Case studies included:

- company and industry context,
- description of applied TQM and green practices,
- semi-structured interviews with managers and key employees,
- identification of success factors and constraints.

- Document Analysis:

Documents analyzed included:

- ISO 9001 and ISO 14001 certificates,
- quality and energy efficiency reports,
- internal policies and procedures.

3.4. Justification for the Selection of KPI Indicators

The selected KPI indicators are conceptually aligned with TQM principles and the ESG framework, enabling measurement of the economic, environmental, and social effects of the integrated system:

- process productivity – economic and operational efficiency,
- number of errors and defects – quality and waste reduction,
- resource consumption – environmental efficiency,
- employee satisfaction – social dimension,
- organizational competitiveness – governance and strategic dimension.

These indicators allow a direct link between TQM practices and ESG performance, consistent with previous empirical research conducted in similar industrial environments [14], [21].

4. Results and Discussion

This section presents and analyzes the empirical data collected from surveys and case studies conducted in Macedonian manufacturing companies. The analysis is structured to allow a clear comparison between companies applying only TQM and those with integrated TQM + green practices.

The study covered a total of six manufacturing companies from different industrial sectors in North Macedonia (Table 1). The companies were divided into two groups:

- companies with an established TQM system,
- companies with integrated TQM and green (environmental) practices.

Table 1. Company group

Company Group	Number of Companies	Characteristics
TQM only	3	Companies with an established TQM system, without green practices
TQM + Green	3	Companies with an integrated TQM and green practices system

The collected data were checked for validity and completeness, and document analysis (ISO 9001, ISO 14001, energy efficiency reports, and quality reports) was used as an additional verification tool.

The survey was conducted among management and employees using a 5-point Likert scale to measure perceptions of the impact of TQM and green practices on organizational performance.

The quantitative analysis focused on key performance indicators (KPIs) relevant to both TQM and sustainable operations.

The analyzed KPIs included:

- process productivity,
- number of errors and defects,
- resource consumption,
- employee satisfaction,
- organizational competitiveness.

Table 2 presents a comparative analysis of average KPI values, showing that the integrated TQM + green practices model leads to a significant 58% reduction in defects and an 11% increase in productivity compared to the TQM-only group.

Table 2. Comparative KPI analysis: TQM-only vs. TQM + green practices

KPI Indicator	TQM only (Mean)	TQM + Green (Mean)	Difference (%)
Process Productivity	78%	89%	+11%
Defects / Errors	12	5	-58%
Resource Usage (kWh)	1000	820	-18%
Employee Satisfaction	3.8/5	4.5/5	+18%
Competitiveness	70	85	+21%

The results indicate that companies with the integrated model generally achieve higher process productivity, fewer errors and defects, and more efficient resource utilization compared to companies applying only TQM.

Figure 2 illustrates the performance gap between the two groups, highlighting how the synergistic effect of integrated management consistently produces higher mean scores across all analyzed organizational categories.

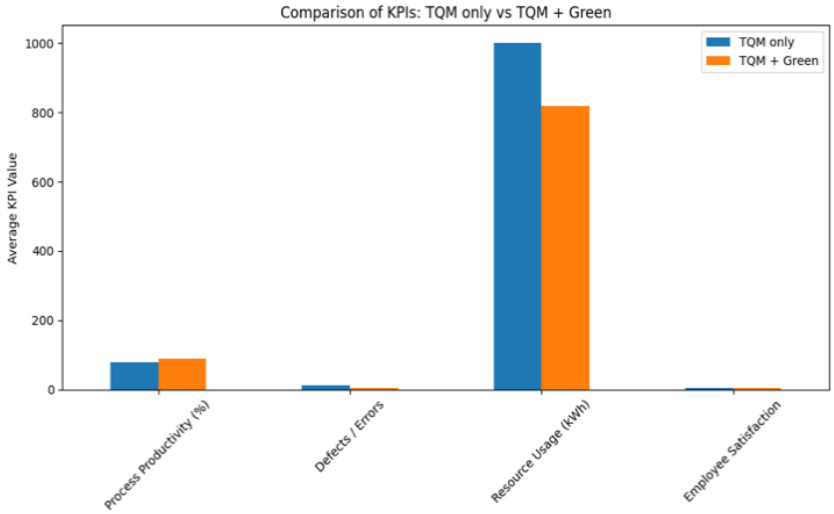

Figure 2. Comparison of average KPI values between TQM-only and TQM + green practices companies

The chart clearly demonstrates that the integrated approach generates a synergistic effect, where improvements in quality and environmental responsibility mutually reinforce each other. Particularly noteworthy is the reduction in defects, indicating that green practices contribute to better process control and standardization.

The qualitative analysis in this study includes a comparative assessment and a visual presentation of the results.

The qualitative findings show that companies with the integrated model exhibit:

- stronger managerial support,
- more clearly defined KPIs,
- greater employee involvement.

Employees perceive the integration of quality and sustainability as a factor that strengthens organizational purpose and culture.

For a clearer interpretation of the data, the results are also presented graphically in Figure 3.

Figure 3 provides a visual heatmap that identifies areas of strongest impact, specifically showing how integrated companies achieve more uniform excellence in resource efficiency and competitiveness.

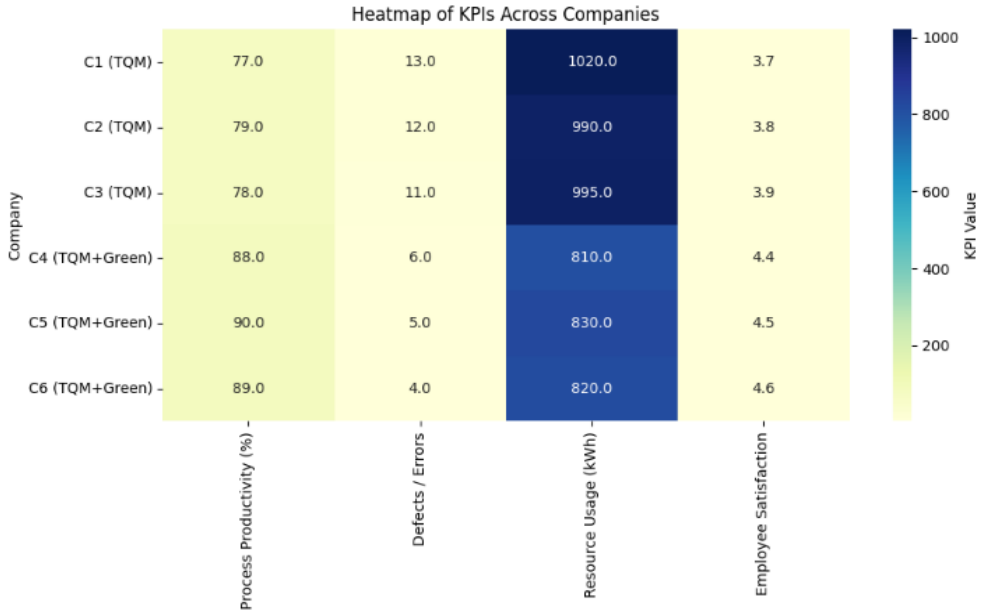

Figure 3. Heatmap of KPI performance across analyzed companies

Results indicate that companies with the integrated TQM + green model achieve higher productivity, fewer defects, and more efficient resource use compared to TQM-only companies. The heatmap illustrates differences in performance between TQM-only and TQM + green practices companies. Additionally, the heatmap analysis (Figure 3) allows a visual identification of areas where the integrated model has the strongest impact.

The findings of this study provide a comprehensive insight into the integration of TQM and green practices in Macedonian manufacturing companies. Quantitative analysis shows that companies applying the integrated TQM + green practices model consistently achieve better results across all KPI indicators compared to TQM-only companies, including process productivity, defect reduction, resource efficiency, employee satisfaction, and competitiveness.

Quantitative results indicate clear differences between TQM-only companies and those with the integrated model. As shown in Table 2, process productivity increased by 11% in integrated companies, demonstrating how continuous improvement, process standardization, and optimization of environmental practices enhance operational efficiency. This aligns with the findings presented in [5] and [11], who indicate that TQM principles facilitate more effective application of sustainable practices.

Errors and defects decreased by 58%, showing a strong correlation between quality management and the optimization of environmental processes. Specifically, defect counts were significantly lower in integrated companies (5 vs. 12), indicating improved process control and standardization.

Reduced defects not only lower costs but also decrease waste, a key element of sustainable production [3].

Resource consumption decreased by 18%, indicating that the integration of green practices enables efficient use of energy and raw materials. This result confirms previous literature demonstrating that TQM and environmental initiatives are synergistic and promote rational resource use [12], [13].

Employee satisfaction increased by 18%, showing that involvement in quality and sustainability activities enhances motivation, engagement, and organizational culture. Integrated companies reported higher employee satisfaction (4.5/5) compared to TQM-only companies (3.8/5), as well as a higher perception of organizational competitiveness.

These findings align with studies emphasizing the importance of employee engagement in integrated management systems [2], [4], [18].

Competitiveness increased by 21%, highlighting the strategic advantage of the integrated approach, as companies are better prepared to meet market demands, regulatory standards, and stakeholder expectations.

The findings demonstrate that TQM and green practice integration generates a synergistic effect, improving operational efficiency and sustainability outcomes. Companies maintaining structured quality processes while implementing environmental practices show higher performance in productivity, resource efficiency, and competitiveness. Furthermore, employee involvement and organizational culture play a key role in sustaining these improvements.

The Macedonian context presents specific challenges, including limited resources and resistance to change. However, the study indicates that tailored strategies, such as phased implementation, leadership-driven communication, and KPI-based monitoring, can overcome these barriers and enable successful integration.

5. Discussion of the Results

Synergistic Effects of TQM and Green Practices: Findings confirm that integrating TQM and green practices produces a synergistic effect beyond the isolated application of each approach. Increased productivity and significant defect reduction in integrated companies can be explained by the principles of continuous improvement and process control, which are core elements of TQM and simultaneously enable systematic management of environmental aspects [1], [2].

Reduced resource consumption indicates that green practices do not act as an additional cost but as a process optimization mechanism. This finding is consistent with previous studies showing that environmental initiatives, when integrated into existing quality management systems, enhance both economic and environmental performance [3], [5].

Organizational Culture and Employee Involvement: Higher employee satisfaction in integrated companies indicates that the TQM + green model also has a significant cultural dimension. Employee involvement in quality and sustainability activities fosters a sense of belonging and shared responsibility, consistent with the philosophy presented in [6] regarding the role of employees in continuous improvement. These results suggest that successful implementation of the integrated model depends not only on technical tools but also on organizational culture and leadership.

These findings reinforce the notion that TQM and ESG are not merely technical tools but also cultural and motivational mechanisms.

Case studies provide detailed examples and KPI results, emphasizing the importance of integrating TQM and green practices. Interviews and case studies highlighted the following themes.

Table 3 summarizes the qualitative findings from case studies and interviews, highlighting the primary organizational advantages gained from integration alongside the common structural barriers faced by Macedonian companies.

Table 3. Qualitative analysis results: Themes, advantages and barriers

Theme	Description
Advantages	Increased environmental responsibility, improved organizational culture, enhanced reputation
Barriers	Limited resources, insufficient training, resistance to change
Key Success Factors	Strong leadership, continuous communication, gradual implementation of green practices

Comparative and Integrated Presentation:

Case studies revealed that companies with a higher level of integration:

- have clearly defined environmental objectives,
- use KPI indicators to monitor progress,
- invest in continuous employee training.

Simultaneously, the identified barriers include:

- limited financial resources,
- resistance to change,
- insufficient institutional support.

As a result of the research, the following conclusions can be drawn:

- The integrated TQM + green practices model improves organizational KPIs, competitiveness, and corporate reputation.
- The most common barriers are limited resources and resistance to change, but these can be overcome through training and employee involvement.

- Key factors for successful implementation include leadership, continuous improvement, phased integration of green practices, and clear communication with employees.
- An adapted integrated model can increase sustainability and deliver economic and environmental benefits in the Macedonian context.

Comparison with Relevant Literature**:**

The results are consistent with the findings reported in [14] and [17], which indicate synergistic effects from the integration of TQM and environmental practices. Unlike studies conducted in developed economies, this study demonstrates that such effects are achievable even under conditions of limited resources and institutional weaknesses.

ESG Logic in Small Economies**:**

In small economies such as the Republic of North Macedonia, ESG practices are not primarily driven by regulatory pressure or investor expectations but represent an internal mechanism for efficiency, stability, and competitiveness. Integrating ESG via TQM enables companies to overcome limitations related to financial and institutional resources. This approach aligns with the need for business process optimization as a prerequisite for sustainability in emerging markets [20].

Role of the Institutional Context:

Weak regulatory enforcement and limited institutional support increase the importance of internal management systems. In this context, TQM functions as a substitute for external institutional mechanisms, providing discipline, control, and accountability.

6. Conclusion

This research provides empirical insight into the effects of integrating TQM and green (environmental) practices in Macedonian manufacturing companies. The results of the pilot study indicate that companies implementing the integrated TQM + green practices model achieve better organizational performance compared to TQM-only companies, particularly in terms of process productivity, defect reduction, efficient resource utilization, and employee satisfaction.

The scientific contribution of this study lies in the empirical confirmation that TQM principles provide an adequate and functional foundation for the systematic integration of green practices, creating a synergistic effect between quality, efficiency, and sustainability. Unlike existing studies, which mainly focus on developed economies, this research provides evidence from a small developing economy characterized by specific institutional and resource constraints.

Practical implications suggest that management should treat TQM and green practices as complementary initiatives, aligning business process optimization with broader ESG goals. The integrated approach allows better performance monitoring through KPIs, more efficient resource management, and strengthened organizational culture through employee engagement. Key factors for successful implementation include leadership, continuous training, and phased integration of green practices into existing quality management systems.

Despite the relevant findings, the study has certain limitations related to sample size and the pilot nature of the study, which restrict the generalizability of the results. Future research should include a larger number of companies, different industrial sectors, and a longer time horizon to examine the long-term effects of TQM and green practices integration in greater depth.

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