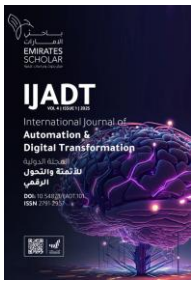

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Digital Transformation and Its Impact on Quality Management in Logistics Companies

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ABSTRACT

The objective of this study is to explore how digital transformation reshapes quality management practices in logistics companies. By analyzing three logistics firms implementing digital solutions, we examine how these technologies affect leadership, culture, processes, and customer satisfaction. this research includes a qualitative content analysis of literature and an empirical study featuring semi-structured interviews. Key findings demonstrate that digital transformation enhances efficiency, optimizes processes, and fosters continuous improvement, yet challenges such as employee resistance and technological setbacks persist. This study is valuable for logistics managers seeking to navigate digital transitions while preserving high-quality management standards.

Introduction

Digital transformation profoundly alters businesses and their environments, revolutionizing how companies operate and interact with their ecosystems. For logistics companies, this shift introduces automation, data integration, and digital platforms, enabling innovative business models and customer-oriented strategies. However, adapting quality management practices to this technological paradigm remains a challenge.

Quality management encompasses principles like leadership, customer focus, process improvement, and decision-making. Traditionally, these principles are applied across organizational levels to ensure superior product and service quality (ISO, 2015). The integration of digital technologies introduces novel opportunities and complexities for these principles, reshaping them to meet evolving market demands.

Digital transformation affects leadership strategies, employee engagement, customer relationships, and decision-making frameworks (Elg et al., 2020). This study investigates these effects in logistics firms that have adopted specific digital solutions. The research aims to answer the following questions:

1. What organizational aspects are impacted by digitalization?

2. How are quality management practices affected by digital transformation?

3. What changes occur within quality management practices as a result of digital transformation?

Mobile and interactive applications ensure connection with customers and other stakeholders (Ralea et al., 2019). Digital transformation enhances the revision, optimization and standardization of business processes and procedures (Sjödin et al., 2018; Mayakova, 2019; Tabrizi et al., 2019; Menshikova et al., 2019), as well as calls for the revision and standardization of business process terminology (Ivančić et al., 2019). Digitalisation may also become one of new quality management principles along with innovation and adaptability (Mayakova, 2019). However, the role of quality management in the process of digital transformation and the resulting changes in the practices of quality management have been studied quite little, therefore, these issues invite for the further research.

Quality management encompasses the entire organization and influences all of its activities. The principles of quality management are the fundamental beliefs, values, norms, and rules that serve as a foundation for managing quality. The seven core quality management principles defined by experts from the International Organization for Standardization (ISO) are: Customer Focus, Leadership, Engagement of People, Process Approach, Improvement, Evidence-Based Decision Making, and Relationship Management (International Organization for Standardization, 2015; Quality Management Principles, 2015). These principles provide guidance for organizational development and performance enhancement. This study adopts ISO-based quality management principles because the quality management systems of the participating companies are built on these principles, even though they are not formally certified.

Quality management practices refer to the actions and procedures implemented by an organization to ensure the delivery of high-quality products or services (Barros et al., 2014). In this paper, quality management practices are understood as the adoption and practical application of quality management principles within the organization and its business activities to achieve the highest quality in its products and services. These practices include, but are not limited to, management leadership, human resources, education and training, teamwork, customer focus, supplier management, quality data and reporting, strategic planning, quality systems, quality culture, employee management, process management, product/service design, continuous improvement, quality tools and techniques, project management, change management, service-level management (SLM), content management, information and security management, and service reporting (Basu & Bhola, 2016).

1. Digital Transformation

Digital transformation redefines organizational structures, workflows, and business models. It involves leveraging technologies like IoT, AI, and big data to enhance operational efficiency and decision-making (Prokhin, 2020). In logistics, these technologies facilitate real-time tracking, inventory management, and predictive analytics. It is directly connected with innovation – an innovation is being pre-requisite and enabler of digital transformation (Armengaud et al., 2017), which in turn boosts

innovation further and contributes to the emergence of culture of innovation (Tabrizi et al., 2019; Mayakova, 2019; Manita et al., 2020). The definitions of digitalization and digital transformation refer to the same process—the transformation of an organization aimed at creating a unified digital environment by integrating various data management tools and techniques throughout the entire product creation cycle (Kovrigin & Vasiliev, 2020).

Impact on Quality Management

Digital transformation and quality management share a common goal: improving organizational performance. However, the integration of technologies requires revisiting quality management principles, such as:

- **Customer Focus**: Digital platforms enable direct customer interactions, fostering real-time feedback and personalized services (Mazzuto & Ciarapica, 2019).
- **Leadership**: Transformational leadership drives digital adoption, ensuring alignment between technological capabilities and organizational goals (Tabrizi et al., 2019).
- **Improvement**: Automation reduces errors, accelerates workflows, and enhances product quality, but demands continuous optimization of processes (Dewhurst et al., 1999).

Digitalization offers significant opportunities for advancing quality management (QM). It can minimize the influence of the "human factor" in identifying and preventing non-conformities and errors (Menshikova et al., 2019; Manita et al., 2020). Various sensors and applications enable the real-time recording of performance indicators and process controls (Prokhin, 2020), facilitating process and performance management through the digitalization of quality control practices. Improved product traceability, essential in industries like food and pharmaceuticals, is made possible through RFID and other digital technologies (Ebert & Duarte, 2018; Savina et al., 2020)

Challenges in Logistics

While the benefits of digitalization are evident, challenges such as employee resistance, cybersecurity concerns, and technological interoperability hinder implementation. These issues highlight the need for effective change management strategies and robust quality management practices (Mayakova, 2019; Elg et al., 2020).

Digital transformation is changing the shape of labor market and can increase inequality between genders and occupational groups (Dengler & Tisch, 2020). There is no doubt that digitalization contributes to the formation and development of new skills, abilities and competences of personnel, not limited only to digital and IT skills, but also abilities to work with Big Data, dealing with complexity and problem solving in a new business environment (Lola & Bakeev, 2020).

2. Methods and Procedures

This study adopts a four-phase methodology, adapted to investigate the effects of digital transformation on quality management in logistics companies. The methodology integrates qualitative content analysis, empirical data collection, and validation to answer the research questions.

Phase 1: Literature Review

A comprehensive review of scholarly articles was conducted, using databases such as Scopus, Web of Science, and Google Scholar. Keywords like *digital transformation*, *quality management*, *Industry 4.0*, and *logistics* were combined to identify relevant sources. Papers were selected based on their relevance to the research questions and their contributions to understanding digital transformation's impact on organizational practices.

Phase 2: Qualitative Content Analysis

The selected literature was analyzed using open coding, identifying recurring themes related to the interplay between digital transformation and quality management practices. Key categories included leadership, process improvement, customer focus, and employee engagement.

Phase 3: Empirical Study

To validate the findings from the literature, three logistics companies were selected for case study analysis. These companies implemented digital

solutions aimed at improving operational efficiency. Semi-structured interviews were conducted with nine representatives, including project managers, operations officers, and quality specialists. Interview durations ranged from 45 to 60 minutes. Table 1 explains the profile of interviewed participants

Table 1. Profile of Interviewed Participants

Company	Role	Number of Participants
Company A	Project Manager	2
Company B	Chief Operations Officer	3
Company C	Quality Specialist	4

The interviews focused on the implementation of two digital solutions: SmartCheck (for automated inventory management) and VoiceCommand (a voice-directed picking system).

Phase 4: Validation

The findings were shared with the same interview participants for feedback and confirmation. Their input ensured the accurate interpretation of results and added depth to the analysis.

3. Results and Discussion

Overview of Digital Solutions

The study examined the implementation of two digital solutions across the participating companies:

1. SmartCheck: This system automates inventory monitoring and updates, enhancing data accuracy and reducing manual errors.

2. VoiceCommand: A voice-directed picking system designed to streamline warehouse operations and increase worker productivity.

Table 2. Digital Solutions Implementation Timeline

Company	SmartCheck Implementation	Voice Command Implementation
A	Q1 2023	Q3 2023
B	Q2 2023	Q4 2023
C	Q4 2023	Q1 2024

Table 2 presents the timeline for implementing two digital solutions, *SmartCheck* and *VoiceCommand*, across three logistics companies (A, B, and C). The staggered adoption reflects the varied operational priorities and readiness of each company. Company A was the first to implement both solutions, starting *SmartCheck* in Q1 2023 and *VoiceCommand* in Q3 2023. Company B followed, completing its implementation in Q2 2023 and Q4 2023, respectively. Company C experienced delays, implementing *SmartCheck* in Q4 2023 and *VoiceCommand* in Q1 2024. This timeline provides a foundation for analyzing how implementation sequencing influences the effectiveness and challenges of digital transformation.

Key Findings

Leadership and Strategy

All companies emphasized the importance of leadership in driving digital transformation. The strategic integration of these solutions required clear communication, top management support, and resource allocation. Leadership played a vital role in resolving tensions between developers and end-users.

Process Improvement

Both solutions contributed to significant process optimization:

- **SmartCheck** reduced inventory discrepancies by 85%, enhancing stock accuracy.
- **VoiceCommand** improved picking speed by 30%, although initial resistance from employees slowed adoption.

Customer Focus

The digital solutions indirectly benefited customers by reducing delivery errors and improving service

reliability. However, customer-centricity was not the primary driver for these implementations.

Employee Engagement and Resistance

Table 3: highlighted varied responses to digital transformation across the three companies. While employees recognized the long-term benefits of digitalization, initial resistance was notable due to fears of job redundancy and unfamiliarity with the systems.

Table 3. Employee Feedback on Digital Solutions

Aspect	A	B	C
Perceived Ease of Use	Moderate	High	Low
Training Effectiveness	High	Moderate	Moderate
Initial Resistance Level	Moderate	Low	High
Adoption Timeline (Months)	3	2	6

Key findings included:

• Employees at C exhibited the highest resistance, citing inadequate training and technical issues.

• B demonstrated a smoother transition, credited to prior experience with similar systems.

• Continuous training and feedback loops were crucial in mitigating resistance and building trust in the new technologies.

Quantitative Impacts of Digital Solutions

To measure the effectiveness of SmartCheck and VoiceCommand, key performance indicators (KPIs) were analyzed before and after implementation as showed in table 4.

Table 4. Key Performance Indicators

KPI	Pre-Implementation	Post-Implementation	Improvement (%)
Inventory Accuracy (%)	72	94	30
Picking Speed (Orders/Hour)	60	78	30
Order Error Rate (%)	8	2	-75
Labor Costs ($/Month)	15,000	11,000	-27

The results indicate that both solutions significantly enhanced operational efficiency, particularly in reducing errors and optimizing labor costs. These improvements align with findings from previous studies (Prokhin, 2020; Sjödin et al., 2018).

Challenges Encountered

Despite the measurable benefits, challenges were prevalent:

1. **Technical Issues:** Both solutions faced initial glitches, requiring iterative improvements during the implementation phase.

2. **Employee Training:** Inconsistent training effectiveness prolonged adoption timelines, particularly in Gamma.

3. **Interdepartmental Coordination:** Misaligned expectations between IT and operations teams occasionally delayed progress.

Integration of Quality Management Practices

The study found that digital transformation reshaped core quality management practices:

• Process Approach: New workflows required detailed documentation and frequent updates.

• Leadership: Strong leadership ensured alignment between digital goals and operational realities.

• Continuous Improvement: The iterative nature of the implementations demonstrated a shift toward a culture of ongoing refinement.

4. Conclusion

This study reaffirms the transformative impact of digitalization on logistics companies. By adopting technologies like SmartCheck and VoiceCommand, organizations can achieve substantial improvements in efficiency, accuracy, and cost management. However, the success of these transformations' hinges on leadership commitment, employee engagement, and robust training programs.

While digital transformation offers clear advantages, challenges such as employee resistance and technical barriers underscore the importance of adopting a structured, quality-focused approach. Future research should explore the long-term sustainability of such solutions and their broader impact on customer satisfaction.

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