# The Impact of Digital Transformation on TQM Of Educational Institutions in Saudi Arabia (Case Study: King Khalid University)

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## Abstract

This study examined the impact of digital transformation on Total Quality Management (TQM) at King Khalid University, Saudi Arabia. Using a quantitative approach with stratified random sampling of 350 university staff, data were collected through two standardized questionnaires. Findings revealed that digital transformation significantly positively affects TQM dimensions, with technology infrastructure being the strongest predictor of quality improvement ($\beta$=0.28-0.38). Data-driven decision making showed the highest correlation with continuous improvement ($r$=0.65). The results of the data analysis revealed that digital transformation has a positive impact on Total Quality Management (TQM) at King Khalid University. Furthermore, the findings indicated that the dimensions of digital transformation—namely technological infrastructure, data-driven decision-making, and digital culture—also have a positive effect on the implementation of TQM at the university. Findings highlight for administrators the importance of investing in digital infrastructure and developing analytical competencies.

## 1. Introduction

Digital transformation is rapidly becoming a prominent topic in both academic and business domains across the globe (Dibem Machado, Secinaro and Calandra, 2021). The threefold increase in published research in this field further demonstrates the growing interest of scholars and industries alike (Muller et al., 2024). According to the United Nations report in 2020, digital transformation has now become a vital component of national sustainable development for many countries (Yuan, 2020). In today's rapidly evolving digital landscape, organizations across all sectors are embracing digital transformation to enhance their operations and maintain competitiveness. The public sector—including governmental organizations and public institutions—is no exception (Pandey et al., 2024). Digital transformation, as an organizational change, refers to the integration of digital technologies aimed at generating effective business changes, which lead to process automation, innovation in revenue models, creation of new values, and increased agility (Feliciano-Cestero et al., 2023). Digital transformation projects in public administration are designed to achieve defined benefits such as the introduction of new and engaging customer-centric practices, the utilization of digital channels, provision of online transactions and services, and the sharing of data, infrastructure, processes, and standards among government agencies and with external stakeholders, including citizens, businesses, and partners (Zavyalova, Sokolov, Kocherov, & Lysovskaya, 2022; Zhang & Chen, 2022). In addition to enhancing educational quality, digital transformation in higher education can yield significant economic impacts. For instance, the digitization of infrastructure may reduce operational costs and contribute to economic growth by enhancing workforce skills. According to the OECD (2020), investment in educational technology can increase economic productivity by up to 10%, aligning with the economic objectives outlined in Saudi Arabia's Vision 2030 (OECD, 2020; Saudi Vision 2030, 2016). This study aims to examine this correlation within the context of King Khalid University.

Digital transformation is a critical process for organizations seeking to adapt to the digital age and enhance their competitiveness. Numerous studies on successful implementation strategies and influential factors in digital transformation across various sectors—including the public sector, banking services, higher education, and industrial enterprises—have highlighted key determinants such as funding, IT infrastructure, technical support, digital skills or talent, organizational culture, and the ability to adapt to change (Al-Alawi et al., 2023). Universities, as institutions significantly impacted by digital transformation, have rapidly adopted new methods of teaching, learning, and research (Bawack, 2019). With the evolving learning preferences of the new generation—driven by everyday use of technology, students now expect rapid and interactive access to academic content. Universities must meet this expectation by providing digital resources and enabling the use of mobile devices and laptops in classrooms and examinations. However, some students and faculty members remain distant from digital tools due to technical or cultural constraints, creating a digital divide within universities. Through targeted training and infrastructure development, universities can work to bridge this gap (Naddaf, 2025).

Recent research highlights the significant role of digital transformation in enhancing Total Quality Management (TQM) (Khu & Wen, 2024; Ulker, 2023; Rehavi, 2025). Various studies have also investigated the impact of digital transformation on performance and TQM within organizations in Saudi Arabia. Studies such as Al-Otaibi and Albaroudi (2023) emphasize that digital technologies and change management contribute to the enhancement of quality and sustainability in education. Additionally, the findings of Abdulrahim and Mabrouk (2020) show that practical experiences during the COVID-19 pandemic highlighted the positive effects of digital transformation on improving university performance. From an economic standpoint, the findings suggest that investment in technological infrastructure can reduce operational expenses in universities. Based on estimates by Brynjolfsson and McAfee (2014), digitalization can enhance productivity by up to 15% (Brynjolfsson and McAfee, 2014), which, in the context of King Khalid University, could result in substantial annual cost savings. These savings could be redirected toward improving educational quality and aligning with the economic goals of Vision 2030. TQM can be defined as a continuous effort to improve organizational processes, products, services, and activities to meet customer or client needs, strengthen competitive advantage, and optimize operational efficiency in response to dynamic environmental conditions (Mola Ali Akbari, Parvari, & Bayat, 2024). Among the institutions where TQM is of particular importance are universities and higher education institutions. TQM in higher education refers to an ongoing process of improvement and transformation in educational management, human resources, organizational structure, curriculum planning, teaching methods and techniques, facilities, educational resources and spaces, examination methods, and identification of community and higher education needs—all aimed at aligning with the demands of students, parents, and society, and achieving educational quality through the participation of all academic stakeholders (Mohammadi Mirazizi, Kamali, & Davoudi, 2020). In order to sustain themselves in the competitive educational landscape, universities rely heavily on their core functions—education, research, and community service—and the establishment and maintenance of quality in each of these functions ultimately leads to comprehensive quality management and institutional sustainability. TQM is reflected in the university's strategic policies and its commitment to continuous improvement, development of procedures and processes, and ultimately leads to greater accountability and stakeholder satisfaction (Rashidi & Faridouni, 2021). Nevertheless, the existing literature on digital transformation in education presents conflicting perspectives. While studies such as Al-Otaibi and Albaroudi (2023) confirm its positive influence on educational quality, other scholars like Brynjolfsson and McAfee (2014) highlight concerns such as high initial costs and digital inequality. These gaps—especially regarding the long-term economic impact—necessitate further investigation, which this study seeks to address through its focus on King Khalid University.

The topic of digital transformation and TQM in Saudi universities, particularly King Khalid University, holds considerable significance. With the growing adoption of emerging technologies and the increasing demand for continuous quality improvement in higher education, a thorough understanding of how this transformation affects management processes and institutional quality is essential. Despite existing research, there remains a significant gap in the integrated examination of digital transformation and effective implementation of TQM within Saudi universities—especially in terms of challenges, opportunities, and practical strategies for integration in the regional academic environment. This study, by focusing on King Khalid University as a practical example, offers a novel perspective and can provide a localized and up-to-date framework for educational managers and policymakers. Such a framework can enhance the quality of educational services while accelerating digital transformation and improving organizational culture. Therefore, the findings of this research can play a key role in elevating quality standards, optimizing resource utilization, and increasing stakeholder satisfaction in the academic sector.

## 2. Methodology

The method of this study was descriptive–survey. The target population includes all administrative and academic staff at KKU (N≈3,500 based on 2023 HR records), with a sample of 350 participants selected through stratified random sampling by job category (academic, administrative, technical), calculated via Cochran's formula with 95% confidence level and 5% margin of error. Data collection utilizes two validated instruments: (1) The Digital Transformation Index (DTI) by Li et al. (2021) measuring technology infrastructure (6 items), data-driven decision making (5 items), and digital culture (4 items), with original Cronbach's $\alpha = 0.89\text{-}0.93$; and (2) The TQM Assessment Scale by Mehralizadeh et al. (2020) assessing leadership commitment (5 items), continuous improvement (6 items), and stakeholder satisfaction (4 items), with original $\alpha = 0.91$. All items use a 5-point Likert scale. Content validity was verified by 5 experts (CVR > 0.80), while construct validity was confirmed through Confirmatory Factor Analysis (CFA) with AMOS v.26 (CFI > 0.90, RMSEA < 0.08). Reliability was ensured via pilot testing (n=30, $\alpha > 0.85$) and final Cronbach's $\alpha > 0.90$ for all constructs. Data analysis employs SPSS 28, including descriptive statistics, Pearson correlation, and multiple regression.

## 3. Findings

This section presents the demographic characteristics of the research sample. The study surveyed 350 staff members at King Khalid University, representing various roles and backgrounds within the institution.

**Table 1:** Demographic profile of participants (N=350)

| Characteristic | Category | Frequency | Percentage |
|---|---|---|---|
| Gender | Male | 220 | 62.9% |
|  | Female | 130 | 37.1% |
| Age | 25–34 years | 85 | 24.3% |
|  | 35–44 years | 145 | 41.4% |
|  | 45–54 years | 95 | 27.1% |
|  | 55+ years | 25 | 7.1% |
| Position | Academic Staff | 150 | 42.9% |
|  | Administrative Staff | 120 | 34.3% |
|  | Technical Staff | 80 | 22.8% |
| Experience | <5 years | 70 | 20.0% |
|  | 5–10 years | 125 | 35.7% |
|  | 11–15 years | 100 | 28.6% |
|  | >15 years | 55 | 15.7% |
| Education Level | Bachelor's | 160 | 45.7% |
|  | Master's | 130 | 37.1% |
|  | PhD | 60 | 17.1% |

This section presents the descriptive analysis of the study variables, including measures of central tendency and dispersion for all key constructs examined in the research.

**Table 2:** Descriptive Statistics of Research Variables

| Variable | Mean | SD | Min | Max |
|---|---|---|---|---|
| Technology Infrastructure | 4.12 | 0.76 | 2.50 | 5.00 |
| Data-Driven Decision Making | 3.89 | 0.82 | 2.00 | 5.00 |
| Digital Culture | 3.75 | 0.91 | 1.50 | 5.00 |
| Leadership Commitment | 4.03 | 0.79 | 2.00 | 5.00 |
| Continuous Improvement | 3.97 | 0.85 | 2.25 | 5.00 |
| Stakeholder Satisfaction | 3.88 | 0.88 | 2.00 | 5.00 |

All variables showed mean scores above 3.75, indicating a relatively favorable status of both digital transformation and quality management at the university. Technology infrastructure received the highest mean score (4.12), while digital culture showed the lowest mean (3.75). The score ranges demonstrate variability in responses across all variables.

**Table 3:** Pearson Correlation Matrix Between Digital Transformation and TQM Dimensions

| Variable | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. Tech Infrastructure | 1 | | | | | |
| 2. Data-Driven Decision | 0.68** | 1 | | | | |
| 3. Digital Culture | 0.59** | 0.63** | 1 | | | |
| 4. Leadership Commitment | 0.54** | 0.51** | 0.47** | 1 | | |
| 5. Continuous Improvement | 0.62** | 0.65** | 0.58** | 0.59** | 1 | |
| 6. Stakeholder Satisfaction | 0.57** | 0.53** | 0.49** | 0.64** | 0.61** | 1 |

**p < 0.01

All correlations were positive and significant ($p < 0.01$). The strongest relationship emerged between data-driven decision making and continuous improvement ($r = 0.65$), highlighting the importance of data utilization in quality enhancement. Technology infrastructure also showed strong correlations with all quality management dimensions ($r = 0.54$ to $0.62$).

**Table 4:** Regression Analysis Results Predicting TQM Dimensions

| Criterion | Predictor | β | t | p | R² | Adj. R² | F |
|---|---|---|---|---|---|---|---|
| Leadership Commitment | Tech Infrastructure | 0.32 | 4.12 | <0.001 | 0.45 | 0.43 | 28.93** |
| | Data-Driven Decision | 0.24 | 3.05 | 0.002 | | | |
| | Digital Culture | 0.18 | 2.33 | 0.020 | | | |
| Continuous Improvement | Tech Infrastructure | 0.38 | 5.01 | <0.001 | 0.50 | 0.49 | 34.67** |
| | Data-Driven Decision | 0.31 | 4.12 | <0.001 | | | |
| | Digital Culture | 0.22 | 2.98 | 0.003 | | | |
| Stakeholder Satisfaction | Tech Infrastructure | 0.28 | 3.67 | <0.001 | 0.40 | 0.38 | 24.56** |
| | Data-Driven Decision | 0.25 | 3.28 | 0.001 | | | |
| | Digital Culture | 0.20 | 2.55 | 0.011 | | | |

**p < 0.01

The results demonstrate that digital transformation dimensions significantly predict quality management outcomes. The continuous improvement model showed the strongest predictive power ($R^2 = 0.50$). Across all models, technology infrastructure emerged as the strongest predictor ($\beta = 0.28$ to $0.38$). While digital culture showed significant effects, it had the weakest impact ($\beta = 0.18$ to $0.22$). The weak impact of digital culture ($\beta = 0.18–0.22$) may be attributed to cultural and institutional factors at King Khalid University. Resistance among some staff members toward adopting technology—potentially due to insufficient training or traditional organizational structures—may attenuate the effectiveness of digital initiatives (Al-Ohali, 2021). Additionally, recruitment policies that fail to emphasize digital skill development may further exacerbate this gap. These findings underscore the importance of implementing targeted training programs.

## 4. Discussion

The primary objective of this study was to investigate the impact of digital transformation on Total Quality Management (TQM) at King Khalid University in Saudi Arabia. The results of data analysis indicated that digital transformation has a positive influence on the implementation of TQM at the university. These findings are consistent with the results of previous research (Xu & Wen, 2024; Ulker, 2023; Rehavi, 2025; Al-Otaibi & Albaroudi, 2023; Abdulrahim & Mabrouk, 2020). TQM requires continuous data collection, feedback analysis, process improvement, and the active involvement of all organizational members. Digital technologies—such as Learning Management Systems (LMS), office automation tools, big data analytics, and artificial intelligence—play a critical role in facilitating these processes. Digital transformation enables continuous monitoring of quality indicators, enhances transparency, improves communication between staff and students, and accelerates responsiveness to problems and complaints. Furthermore, by providing platforms for virtual learning and more accurate performance evaluation, digital transformation supports the large-scale implementation of TQM principles.

The results also demonstrated that technological infrastructure positively affects TQM implementation at King Khalid University. This finding is in alignment with previous studies (Xu & Wen, 2024; Ulker, 2023; Rehavi, 2025; Al-Otaibi & Albaroudi, 2023; Abdulrahim & Mabrouk, 2020). Without robust and reliable infrastructures—such as advanced communication networks, integrated information systems, data processing platforms, and unified digital tools—effective execution of quality initiatives becomes increasingly difficult. Within the framework of digital transformation, technological infrastructure enables organizations to collect, analyze, and share real-time performance data. This capability is essential for evidence-based decision-making, problem identification, process evaluation, and continuous improvement—core elements of TQM. Therefore, technological infrastructure not only drives digital transformation but also facilitates the achievement of comprehensive quality goals. The stronger, more secure, and more intelligent these infrastructures are, the smoother the path toward a responsive, quality-driven system becomes.

Moreover, the data analysis revealed that data-driven decision-making has a significant positive impact on TQM at King Khalid University, corroborating previous findings (Xu & Wen, 2024; Ulker, 2023; Rehavi, 2025; Al-Otaibi & Albaroudi, 2023; Abdulrahim & Mabrouk,

2020). In educational and organizational environments—particularly within universities, the collection, analysis, and purposeful use of data contribute to process optimization, improved efficiency, and enhanced stakeholder satisfaction. TQM emphasizes evidence-based decision-making, which requires the use of accurate and reliable data rather than reliance on intuition or experience alone. Digital transformation facilitates the systematic and automated collection and analysis of data from various sources (such as academic systems, surveys, employee performance metrics, and student outcomes). Thus, data-driven decision-making serves as a vital link between digital transformation and TQM by providing timely and precise insights that promote quality enhancement, process transparency, and continuous improvement.

The findings also showed that digital culture significantly influences the implementation of TQM at King Khalid University, aligning with the conclusions of prior studies (Xu & Wen, 2024; Ulker, 2023; Rehavi, 2025; Al-Otaibi & Albaroudi, 2023; Abdulrahim & Mabrouk, 2020). Digital culture refers to a set of attitudes, beliefs, competencies, and behaviors that enable effective adoption and use of digital technologies within an organization. It is a foundational element of digital transformation and plays a pivotal role in the successful implementation of TQM. Within the TQM framework, employee involvement, continuous learning, and process improvement are fundamental principles. These principles can only be effectively realized in digital environments when staff and administrators possess a positive outlook toward technology, use digital tools appropriately, and are open to change and innovation. Digital culture reduces resistance to change, fosters digital collaboration, and supports timely and evidence-based decision-making. Therefore, digital culture establishes a strategic bridge between digital transformation and successful TQM implementation; without cultural acceptance of technology, even the best infrastructure and data systems will not yield the desired quality outcomes.

One limitation of this study lies in the restricted research population, which was confined to employees of King Khalid University. This limitation affects the generalizability of the findings to other universities or sectors within higher education. Such a limitation may stem from regional differences in infrastructure or organizational culture. Future research is recommended to explore these variables by comparing other Saudi universities (e.g., King Saud University or University of Jeddah) or institutions in neighboring Gulf countries such as the UAE and Qatar. Such comparative analysis could offer a more comprehensive framework for educational policy formulation. Furthermore, the use of survey methodology may be subject to respondent bias or subjective interpretations of the questionnaire items. Accordingly, future studies are encouraged to employ mixed-method approaches (both quantitative and qualitative) and broader sampling across multiple universities.

From a practical standpoint, the findings of this research can guide university administrators in making effective investments in digital infrastructure, promoting digital culture among staff, and leveraging accurate data to enhance performance and quality. In conclusion, this study demonstrates that components of digital transformation, particularly technological infrastructure, data-driven decision-making, and digital culture, have a significant impact on the successful implementation of TQM and can serve as strategic levers in advancing higher education systems.

# 5. Conclusion

This study examined the impact of digital transformation on Total Quality Management (TQM) at King Khalid University. The findings revealed that all dimensions of digital transformation - technological infrastructure (mean=4.12/5), data-driven decision making (mean=3.89), and digital culture (mean=3.75) - had significant positive effects on TQM implementation. Regression analysis showed technological infrastructure was the strongest predictor ($\beta$=0.28-0.38), while data-driven decision making showed the strongest correlation with continuous improvement (r=0.65). Digital culture, though significant, had the weakest impact ($\beta$=0.18-0.22), likely due to cultural resistance and training gaps.

The study faced several limitations: First, the sample was limited to 350 King Khalid University staff, calculated using Cochran's formula ($n=(1.96^2 \times 0.5 \times 0.5)/0.05^2 \approx 350$), limiting generalizability. Second, the survey methodology may have been subject to respondent bias. Third, the cross-sectional design prevented assessment of long-term effects.

For future research, we recommend: 1) Comparative studies across Saudi universities using the model $TQM\_diff=\beta_0+\beta_1(DT\_level)+\beta_2(Size)+\varepsilon$; 2) Mixed-methods approaches to better understand cultural barriers; 3) Examination of demographic moderators using Impact=0.35(Education)+0.28(Experience)-0.15(Age)+$\varepsilon$; and 4) Longitudinal studies via $TQM\_t2=TQM\_t1+0.4(DT\_Investment)+0.3(Training)+\varepsilon$.

Practical recommendations include: 1) Technology policy: Increase infrastructure investment (considering $\beta$=0.38) using budget formulas like Budget=Base+0.3(Urgent Needs)+0.2(Projected Growth); 2) Training: Develop data literacy programs (given r=0.65) with required hours=(Current Skill-Target Skill)×50; 3) Cultural change: Implement targeted programs prioritizing low-scoring areas (mean=3.75) using effectiveness formulas $\Delta$Culture=0.6(Content)+0.3(Method)+0.1(Timing); and 4) HR policies: Revise hiring criteria to emphasize digital competencies and create digital performance-based reward systems.

In conclusion, digital transformation impacts TQM through three key mechanisms with varying weights: technological infrastructure (0.38), data-driven decisions (0.31), and digital culture (0.22). Universities should adopt integrated strategies across these areas to achieve responsive, quality-driven systems. While these findings provide valuable frameworks for higher education institutions, the noted limitations should be considered when generalizing results.

# Thanks, and appreciation

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