

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

Received	2026/07/29	تم استلام الورقة العلمية في
Accepted	2026/08/23	تم قبول الورقة العلمية في
Published	2026/08/25	تم نشر الورقة العلمية في

The Role of Digital Transformation in Enhancing IT Infrastructure Efficiency: An Applied Study on ARAK – Communication & IT Services Libya

Khadeja Elseddig Jahan

College of Technical Sciences - Misurata , Libya

ORCID: 0009-0004-3793-0735

jhan.khady@gmail.com

Abstract

This study investigates a prominent technology solutions provider within the rapidly developing telecommunications landscape of Libya, serving as one of the early pioneers of technology services in the country's dynamic market. A quantitative descriptive-analytical methodology was adopted, drawing on primary data collected from a purposive sample of 42 employees across various functional departments within the organization. A validated structured questionnaire was used to measure four primary dimensions of digital transformation technology adoption, digital strategy, operational integration, and sustainability orientation alongside four dimensions of IT infrastructure efficiency: cost optimization, service delivery performance, system reliability, and innovation capacity. The findings reveal strong and statistically significant positive relationships between digital transformation initiatives and IT infrastructure efficiency improvements, with the most pronounced effects observed in operational performance, cost reduction, and innovation enablement. Strategic alignment, top management commitment, and organizational capability development emerged as critical mediating factors. The study contributes to the literature on digital transformation in developing country and North African contexts and provides actionable

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

recommendations for ARAK and comparable organizations pursuing sustainable digital development.

Keywords: Digital Transformation, IT Infrastructure Efficiency, ARAK Libya, Telecommunications.

دور التحول الرقمي في تعزيز كفاءة البنية التحتية لتكنولوجيا المعلومات:
دراسة تطبيقية على شركة أراك لخدمات الاتصالات وتكنولوجيا المعلومات

ليبيا

خديجة الصديق جهان

كلية العلوم التقنية، مصراته، ليبيا

jhan.khady@gmail.com

الملخص

تتناول هذه الدراسة واقع إحدى الشركات الرائدة في قطاع الاتصالات المتنامي باستمرار في ليبيا، باعتبارها من طلائع المزودين للخدمات التقنية داخل السوق الليبي الحيوي. ولتحقيق أهداف الدراسة، أُتبعت منهجية وصفية-تحليلية كمية، اعتمدت على جمع بيانات أولية من عينة قصدية بلغت 42 موظفاً يمثلون مختلف القطاعات الوظيفية بالشركة. وقد جرى الاعتماد على استبانة محكمة ومقننة لقياس المحاور الأربعة الأساسية للتحول الرقمي، وهي: تبني التقنية، الاستراتيجية الرقمية، التكامل التشغيلي، والتوجه نحو الاستدامة؛ توازياً مع قياس أربعة أبعاد تعكس كفاءة البنية التحتية لتكنولوجيا المعلومات، وتمثل في: ترشيد التكاليف، كفاءة تقديم الخدمات، موثوقية النظم، والقدرة على الابتكار. وأسفرت النتائج عن وجود علاقات طردية وثيقة وذات دلالة إحصائية عالية بين مبادرات التحول الرقمي ومستويات كفاءة البنية التحتية لتكنولوجيا المعلومات، حيث تركزت التأثيرات الأبرز في مجالات الأداء التشغيلي، وخفض التكاليف، وتمكين الابتكار. كما أثبت التحليل الدور الحيوي لعدة عوامل وسيطة تمثلت في: التوافق الاستراتيجي، التزام الإدارة العليا، وتطوير القدرات التنظيمية وتسهم هذه الدراسة في إثراء الأدبيات العلمية المرتبطة بالتحول الرقمي ضمن بيئات الدول النامية وبصورة خاصة في إقليم شمال

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

إفريقيا، فضلاً عن تقديم حزمة من التوصيات الإجرائية القابلة للتطبيق لكل من شركة
"أراك" والمؤسسات النظرية الساعية لترسيخ تنمية رقمية مستدامة.

الكلمات المفتاحية: التحول الرقمي، كفاءة البنية التحتية لتكنولوجيا المعلومات، شركة
"أراك" ليبيا، الاتصالات، الأداء التشغيلي، الاستدامة، الابتكار.

1. Introduction

The global business environment has undergone unprecedented transformation in recent decades, driven by the rapid evolution of digital technologies and their systemic penetration across economic sectors, governance structures, and social institutions. Digital transformation has become one of the most strategically significant phenomena of the contemporary era, fundamentally reshaping how organizations operate, create value, and sustain competitive positions (Vial, G.,2019). For entities operating within the information technology and communications services domain, the imperatives of digital transformation carry particular weight, as these organizations simultaneously serve as providers and consumers of digital technologies and infrastructure (Nambisan, S., Lyytinen, K., Majchrzak, A., & Song, M. 2017).

Digital transformation encompasses far more than the incremental adoption of new tools or platforms. As demonstrated in the empirical literature, it represents a holistic organizational change process that reshapes business models, operational architectures, and institutional cultures in ways that generate lasting effects on efficiency, innovation, and competitiveness (Tebenko et al., 2024). The transformative potential is particularly pronounced in the domain of IT infrastructure, where digitalization enables organizations to move beyond legacy systems toward agile, data-driven, and interconnected architectures that can respond dynamically to evolving service demands and market conditions (Beitelmal & Alruwaythi, 2025).

ARAK Company represents a compelling empirical context for investigating these dynamics. Operating within Libya's telecommunications and IT services sector, the company has confronted a complex operating environment characterized by post-conflict reconstruction demands, limited legacy infrastructure,

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

regulatory uncertainty, and rapidly growing public and private sector demand for modern digital services. In this context, decisions regarding digital transformation are not merely matters of competitive positioning; they carry direct implications for national economic modernization and the development of Libya's broader information and communications infrastructure.

The relevance of digital transformation to infrastructure efficiency has been consistently affirmed in the international literature. Shostak, Goi, Timchenko, and Yastrubetska (2023) have documented the far-reaching impacts of digital transformation on economic productivity and technological innovation efficiency at the macro level, while at the organizational level, Zhang, Xu, and Ma (2023) have demonstrated that the strategic alignment of IT investment with digital transformation objectives is a critical determinant of efficiency outcomes. Similarly, Yu, Wang, and Moon (2022) have shown that organizations possessing mature digital transformation capabilities consistently outperform their less digitally advanced peers across multiple dimensions of operational performance.

Despite the richness of the international literature, empirical research on digital transformation dynamics in developing country contexts, and particularly in Libya and the broader North African region, remains limited. This study seeks to address this gap by providing a rigorous empirical investigation grounded in primary survey data collected from ARAK employees, analyzed using validated quantitative methods, and interpreted within the frameworks provided by the contemporary international literature.

2. Literature Review

2.1 Conceptual Foundations of Digital Transformation

Digital transformation has been defined and conceptualized in numerous ways across the scholarly literature, reflecting the breadth and complexity of the phenomenon itself. At its core, digital transformation refers to the integration of digital technologies across all dimensions of an organization, resulting in fundamental changes to how the organization operates and delivers value. Tebenko et al.

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

(2024) have conceptualized digital transformation in business as a comprehensive process through which technology reshapes efficiency, innovation, and competitiveness simultaneously, arguing that organizations that approach this transformation strategically and holistically are better positioned to achieve sustainable advantages. Building on this perspective, Halim, Kesuma, and Siregar (2023) have argued that digital transformation strategy is the central organizing framework through which organizations translate technological investments into performance improvements. Their research demonstrates that companies with clearly articulated digital transformation strategies ones that specify goals, allocate resources systematically, and align technology adoption with business objectives consistently achieve superior performance outcomes. This finding has direct relevance for ARAK, where the strategic coherence of digital transformation efforts is a key variable in explaining performance differentials. Hendrawan, Chatra, and Iman (2024) have provided a complementary perspective by examining digital transformation dynamics in the context of small and medium enterprises, highlighting the challenges that organizations with limited resources face in pursuing transformation and the strategic adaptations they must make to navigate these constraints. While ARAK operates at a scale larger than the MSMEs examined in their study, many of the resource and capability constraints they identify are relevant to companies operating in developing country contexts where institutional support for digital transformation is limited.

2.2 Digital Transformation and Infrastructure Efficiency

The relationship between digital transformation and infrastructure efficiency has been explored from multiple perspectives in the recent literature, with consistent findings pointing to substantial efficiency gains across a range of infrastructure types and organizational contexts. Beitelmal and Alruwaythi (2025) offer the most directly relevant analysis for the present study, providing a comprehensive examination of the benefits that digital transformation generates for infrastructure asset management. Their research identifies three primary benefit domains efficiency improvements, cost savings, and performance optimization and



The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

documents the specific mechanisms through which digital transformation creates value within each domain. Efficiency improvements are generated through automation of routine processes, real-time monitoring of infrastructure assets, and predictive maintenance systems that reduce downtime and extend asset lifecycles. Cost savings arise from optimized resource utilization, reduced waste, and the elimination of redundant processes enabled by integrated digital systems. Performance optimization reflects the capacity of digital systems to learn from operational data and continuously improve service delivery quality. Liu, Su, Zhu, Ge, and Ran (2025) have demonstrated the critical role of digital infrastructure in enabling industrial upgrading and environmental sustainability, providing evidence that well-designed digital infrastructure creates positive externalities that extend beyond the immediate efficiency gains realized by individual organizations. Their research highlights the systemic nature of digital transformation benefits, suggesting that organizations like ARAK that invest in robust digital infrastructure not only improve their own operational performance but also contribute to broader ecosystem-level efficiency improvements. Muhajji, Rappe, Halim, and colleagues (2024) have examined the role of technology and infrastructure in improving operational efficiency, providing a framework that distinguishes between cost-reduction-oriented efficiency improvements, service quality-oriented improvements, and innovation-enabling improvements. Their analysis suggests that the most successful digital transformation initiatives are those that pursue all three types of efficiency gain simultaneously, creating mutually reinforcing dynamics that sustain improvement over time.

2.3 Digital Transformation and Organizational Performance

Beyond the specific domain of infrastructure efficiency, the literature documents extensive evidence for the positive relationship between digital transformation and broader dimensions of organizational performance. Zhang, Shi, Shi, and Chen (2022) have provided rigorous empirical evidence for the positive effects of enterprise digital transformation on production efficiency, using a large sample of Chinese listed companies and sophisticated econometric methods to demonstrate causal relationships. Their

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

mechanism analysis identifies two primary pathways: a direct efficiency effect operating through process automation and digital optimization, and an indirect effect mediated by organizational innovation and knowledge management capabilities. The finding that both pathways are significant, and that they interact positively, suggests that the efficiency and innovation benefits of digital transformation are mutually reinforcing rather than traded off against each other. Shostak, Goi, Timchenko, and Yastrubetska (2023) have provided a macro-level perspective on the relationship between digital transformation and economic efficiency, demonstrating that industries and economies that have advanced furthest in their digital transformation journeys consistently achieve superior productivity and innovation outcomes. Their analysis of the role of technological innovation in driving efficiency improvements complements the organizational-level evidence by situating firm-level dynamics within broader economic and technological trends.

2.4 Digital Transformation and Sustainability

The relationship between digital transformation and sustainability has emerged as an increasingly important theme in the contemporary literature, reflecting growing recognition that organizational performance must be evaluated not only in terms of efficiency and profitability but also in terms of environmental, social, and governance dimensions. Alojail and Khan (2023) have provided comprehensive evidence on the positive impact of digital transformation on sustainable development, demonstrating that organizations that pursue digital transformation strategically are better positioned to achieve sustainability goals across environmental, social, and economic dimensions. Their research highlights the role of digital technologies in enabling more efficient resource utilization, reducing waste and carbon emissions, and creating new opportunities for inclusive economic participation. Martínez-Peláez, Ochoa-Brust, Rivera, Félix, and colleagues (2023) have examined the mediating role of stakeholders, key capabilities, and technology in the relationship between digital transformation and sustainability achievement. Their framework emphasizes that digital transformation creates sustainability value not through technology alone but through the interactions between technological

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

capabilities and organizational and stakeholder factors. For ARAK, this insight suggests the importance of engaging employees, clients, and community stakeholders in digital transformation efforts and building the organizational capabilities needed to translate technological investments into sustainable outcomes. Liu, Su, Zhu, Ge, and Ran (2025) have highlighted the green efficiency pathway of digital transformation, demonstrating that digital infrastructure investments generate environmental sustainability benefits alongside economic efficiency gains. Their finding that digital transformation contributes to a "path to green efficiency" through industrial upgrading and environmental sustainability has important implications for how organizations like ARAK should frame and evaluate their digital transformation investments.

3. Research Methodology

3.1 Research Design

This study adopts a quantitative descriptive-analytical research design. The choice of a quantitative approach is consistent with the methodological traditions established in the digital transformation literature, where survey-based quantitative methods have been widely employed to generate generalizable insights about the relationships between digital transformation variables and organizational outcomes (Zhang et al., 2022; Yu et al., 2022; Zhai et al., 2022).

3.2 Study Population and Sample

The study population consists of all employees of ARAK Company who are engaged in roles with direct or indirect involvement in IT infrastructure management, digital transformation initiatives, or technology-related operational functions. Based on organizational records provided by ARAK's human resources department, the total population of eligible employees was estimated at approximately 85 individuals distributed across the company's technical, operational, managerial, and administrative departments

A purposive sample of 42 employees was selected to participate in the study, representing approximately 49.4% of the total eligible population as shown in Table 1. The sample was designed to ensure representation across all major functional departments and

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

hierarchical levels within the organization Table 2. Purposive sampling was selected over simple random sampling to ensure that the sample would include individuals with sufficient knowledge and experience of the study's focal variables digital transformation and IT infrastructure efficiency to provide meaningful and reliable responses to the survey instrument. Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 26.

Table 1: Sample Distribution by Department

Department	Number of Employees	Sample Size	Percentage
Network & Infrastructure	20	10	23.8%
IT Operations	18	9	21.4%
Technical Support	15	7	16.7%
Management & Strategy	12	6	14.3%
Project Management	10	5	11.9%
Finance & Administration	10	5	11.9%
Total	85	42	100%

Table 2: Sample Distribution by Demographic Characteristics

Characteristic	Category	Frequency	Percentage
Gender	Male	34	81.0%
	Female	8	19.0%
Age	Under 30	8	19.0%
	30–39	17	40.5%
	40–49	12	28.6%
	50 and above	5	11.9%
Education	Diploma	5	11.9%
	Bachelor's Degree	22	52.4%
	Master's Degree	11	26.2%
	Doctorate	4	9.5%
Characteristic Gender Age	Category	Frequency	Percentage
	Male	34	81.0%
	Female	8	19.0%
	Under 30	8	19.0%

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

Characteristic	Category	Frequency	Percentage
Job Level Education	30–39	17	40.5%
	40–49	12	28.6%
	50 and above	5	11.9%
	Diploma	5	11.9%

The demographic profile of the sample reveals several noteworthy features. The strong male majority (81%) reflects the gender composition of Libya's IT and telecommunications workforce, a pattern consistent with regional labor market characteristics. The concentration of respondents in the 30–39 age cohort (40.5%) suggests a relatively young and professionally active workforce. The high proportion of degree-holding employees (88.1% with bachelor's degree or above) indicates a technically educated workforce capable of engaging meaningfully with digital transformation initiatives. The experience distribution, with nearly half of respondents having 10 or more years of experience, suggests a workforce with substantial institutional knowledge and contextual understanding of the organization's technological evolution.

3.3 Validity and Reliability

Content validity was established through expert review. A panel of five academic experts in the fields of information systems, digital transformation, and organizational management reviewed the questionnaire items for relevance, clarity, and representativeness. Minor revisions were made based on their feedback before the instrument was finalized. All alpha coefficients are well above the conventionally accepted threshold of 0.70, indicating excellent internal consistency reliability for all scales and sub-scales. The overall alpha values for both the digital transformation (0.923) and IT infrastructure efficiency (0.918) scales indicate particularly high reliability.

4. Findings

4.1 Descriptive Statistics: Digital Transformation Dimensions

Table 3 presents the descriptive statistics for the four dimensions of digital transformation as perceived by ARAK employees.

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

Table 3: Descriptive Statistics – Digital Transformation Dimensions

Dimension	Mean	Std. Dev.	Level of Agreement	Rank
Technology Adoption	3.94	0.612	High	1
Operational Integration	3.82	0.641	High	2
Digital Strategy Alignment	3.71	0.689	High	3
Sustainability Orientation	3.58	0.724	Moderate-High	4
Overall Digital Transformation	3.76	0.638	High	

Note: Scale: 1–2.33 = Low; 2.34–3.67 = Moderate; 3.68–5.00 = High.

The findings reveal that ARAK employees perceive the organization's overall digital transformation level as high (mean = 3.76, SD = 0.638). Technology adoption emerges as the highest-rated dimension (mean = 3.94), indicating strong organizational commitment to acquiring and deploying new digital technologies. Operational integration ranks second (mean = 3.82), reflecting the organization's progress in embedding digital technologies within core operational processes. Digital strategy alignment ranks third (mean = 3.71), while sustainability orientation, though still in the high range, receives the lowest rating (mean = 3.58). This pattern is consistent with findings from the literature indicating that while technology adoption is often the most visible aspect of digital transformation, strategic alignment and sustainability integration represent more advanced and challenging dimensions (Halim et al., 2023; Martínez-Peláez et al., 2023).

4.2 Descriptive Statistics: IT Infrastructure Efficiency Dimensions

Table 4 presents the descriptive statistics for the four dimensions of IT infrastructure efficiency.

Table 4: Descriptive Statistics – IT Infrastructure Efficiency Dimensions

Dimension	Mean	Std. Dev.	Level of Agreement	Rank
Service Delivery Performance	3.89	0.598	High	1
System Reliability	3.81	0.623	High	2
Innovation Capacity	3.73	0.651	High	3

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

Dimension	Mean	Std. Dev.	Level of Agreement	Rank
Cost Optimization	3.67	0.712	Moderate-High	4
Overall IT Infrastructure Efficiency	3.78	0.621	High	

Note: Scale: 1–2.33 = Low; 2.34–3.67 = Moderate; 3.68–5.00 = High

The overall level of IT infrastructure efficiency at ARAK is perceived as high (mean = 3.78, SD = 0.621). Service delivery performance receives the highest rating (mean = 3.89), reflecting the organization's emphasis on client-facing service quality as a primary metric of infrastructure performance. System reliability ranks second (mean = 3.81), consistent with the critical importance of network and system uptime in telecommunications and IT services contexts. Innovation capacity ranks third (mean = 3.73), while cost optimization, though marginally below the high threshold (mean = 3.67), indicates that employees perceive cost management as the dimension most in need of further improvement. This pattern is broadly consistent with the findings of Beitelmal and Alruwaythi (2025), who identified cost savings as one of the primary potential benefits of digital transformation for infrastructure management.

4.3 Item-Level Analysis of Key Variables

To provide a more granular understanding of the study findings, Table 5 presents item-level means for selected high-importance items within each dimension.

Table 5: Item-Level Descriptive Statistics – Selected Items

Item	Mean	Std. Dev.
Digital Transformation Items		
DT1: The organization continuously updates its IT systems with the latest technologies	4.02	0.589
DT2: Digital transformation is driven by a clear organizational strategy	3.78	0.642
DT3: Digital tools are fully integrated into operational workflows	3.86	0.611

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

Item	Mean	Std. Dev.
DT4: Senior management actively champions digital transformation	3.71	0.683
DT5: Digital transformation contributes to environmental sustainability	3.52	0.741
DT6: Employees receive adequate training to leverage digital technologies	3.62	0.718
DT7: Digital data analytics are used to support operational decisions	3.88	0.601
DT8: The organization's digital infrastructure supports scalable service delivery	3.95	0.572
IT Infrastructure Efficiency Items		
IE1: Digital transformation has reduced operational costs significantly	3.64	0.731
IE2: Service delivery speed has improved due to digital system upgrades	3.92	0.581
IE3: System downtime has decreased following digital infrastructure investments	3.83	0.612
IE4: Digital transformation has enabled the development of new service offerings	3.76	0.644
IE5: Automated monitoring systems have improved infrastructure reliability	3.79	0.628
IE6: Digital platforms have enabled more effective cost management	3.61	0.748
IE7: The organization's ability to innovate has been enhanced by digital transformation	3.74	0.657
IE8: Customer satisfaction with IT services has improved due to digitalization	3.87	0.597

The item-level results reveal important nuances within the broader dimensional patterns. The highest-rated items relate to technology currency (DT1, mean = 4.02), scalable digital infrastructure (DT8, mean = 3.95), and service delivery speed improvement (IE2, mean = 3.92), confirming that ARAK's digital transformation investments have generated tangible improvements in core service delivery functions. Conversely, the lowest-rated items environmental sustainability (DT5, mean = 3.52), employee digital skills training

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

(DT6, mean = 3.62), and cost reduction (IE1, mean = 3.64; IE6, mean = 3.61) — highlight areas where the organization's digital transformation journey has further room to progress.

4.4 Correlation Analysis

Pearson correlation coefficients were calculated to examine the bivariate relationships between the four dimensions of digital transformation and the four dimensions of IT infrastructure efficiency. The results are presented in Table 6.

Table 6: Pearson Correlation Matrix – Digital Transformation and IT Infrastructure Efficiency Dimensions

	Cost Opt.	Service Delivery	System Reliability	Innovation Cap.	Overall Efficiency
Technology Adoption	0.671**	0.743**	0.712**	0.758**	0.764**
Digital Strategy	0.689**	0.721**	0.698**	0.742**	0.751**
Operational Integration	0.712**	0.768**	0.731**	0.719**	0.773**
Sustainability Orientation	0.634**	0.681**	0.659**	0.724**	0.694**
Overall DT	0.724**	0.781**	0.748**	0.782**	0.812**

Note: ** $p < 0.01$ (two-tailed).

All correlation coefficients are positive, statistically significant at the 0.01 level, and of moderate to large magnitude, providing strong support for the hypothesized positive relationships between digital transformation and IT infrastructure efficiency. The overall digital transformation score correlates most strongly with overall IT infrastructure efficiency ($r = 0.812$), indicating a very strong positive association between the two constructs. At the dimensional level, operational integration emerges as the digital transformation dimension most strongly correlated with overall efficiency ($r = 0.773$), while service delivery performance and innovation capacity are the efficiency dimensions most strongly correlated with overall digital transformation ($r = 0.781$ and $r = 0.782$ respectively). These correlation patterns are consistent with the theoretical frameworks proposed by Muhajji et al. (2024) and Tebenko et al. (2024), who emphasize the centrality of operational integration in translating

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

digital technology investments into measurable efficiency improvements, and with Chen and Kim's (2023) evidence that digital transformation generates particularly pronounced effects on innovation-related outcomes.

4.5 Multiple Regression Analysis

To examine the predictive relationships between digital transformation dimensions and overall IT infrastructure efficiency, a multiple regression analysis was conducted with the four digital transformation dimensions as predictors and overall IT infrastructure efficiency as the criterion variable. The results are presented in Table 7.

Table 7: Multiple Regression Analysis – Digital Transformation Dimensions as Predictors of IT Infrastructure Efficiency

Predictor	B	SE	β	t	p
(Constant)	0.412	0.218	—	1.890	0.067
Technology Adoption	0.231	0.071	0.289	3.254	0.002
Digital Strategy Alignment	0.247	0.079	0.301	3.127	0.003
Operational Integration	0.298	0.068	0.362	4.382	0.000
Sustainability Orientation	0.178	0.082	0.198	2.171	0.036

Note: $R = 0.871$; $R^2 = 0.758$; Adjusted $R^2 = 0.731$; $F(4, 37) = 28.916$; $p < 0.001$.

The regression model explains 75.8% of the variance in overall IT infrastructure efficiency ($R^2 = 0.758$), with an adjusted R^2 of 0.731, indicating excellent model fit and high explanatory power. The overall model is highly statistically significant ($F = 28.916$, $p < 0.001$). All four digital transformation dimensions make statistically significant independent contributions to the prediction of IT infrastructure efficiency. Operational integration emerges as the strongest individual predictor ($\beta = 0.362$, $p < 0.001$), confirming the critical role of embedding digital technologies within operational workflows in generating infrastructure efficiency gains. Digital strategy alignment is the second strongest predictor ($\beta = 0.301$, $p = 0.003$), consistent with the arguments of Zhang et al. (2023) and Halim et al. (2023) regarding the centrality of strategic coherence in digital transformation. Technology adoption ranks third ($\beta = 0.289$,

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

$p = 0.002$), while sustainability orientation, though statistically significant, contributes the smallest independent effect ($\beta = 0.198$, $p = 0.036$).

Table 8: Regression Analysis – Overall Digital Transformation as Predictor of Individual Efficiency Dimensions

Criterion Variable	B	β	t	p	R ²
Cost Optimization	0.784	0.724	6.558	0.000	0.524
Service Delivery Performance	0.841	0.781	7.722	0.000	0.610
System Reliability	0.812	0.748	7.088	0.000	0.560
Innovation Capacity	0.849	0.782	7.742	0.000	0.611

All models significant at $p < 0.001$.

The simple regression analyses presented in Table 8 reveal that overall digital transformation is a statistically significant predictor of all four individual efficiency dimensions. The largest effects are observed for innovation capacity ($R^2 = 0.611$) and service delivery performance ($R^2 = 0.610$), while cost optimization shows the smallest, though still substantial, effect ($R^2 = 0.524$). These findings are consistent with the empirical evidence provided by Chen and Kim (2023) on the particularly strong relationship between digital transformation and innovation performance, and with Beitelmal and Alruwaythi's (2025) observation that cost savings represent a slightly more distal benefit of digital transformation.

4.6 Analysis of Variance by Demographic Variables

To explore whether digital transformation perceptions and efficiency assessments vary significantly across different employee groups, one-way ANOVA tests were conducted for key demographic variables, as seen in Table 9.

Table 9: ANOVA Results – Digital Transformation and IT Infrastructure Efficiency by Job Level

Variable	Source	SS	df	MS	F	p
Digital Transformation	Between Groups	4.218	3	1.406	4.892	0.006
	Within Groups	10.926	38	0.288		
	Total	15.144	41			

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

Variable	Source	SS	df	MS	F	p
IT Infrastructure Efficiency	Between Groups	3.817	3	1.272	4.187	0.012
	Within Groups	11.556	38	0.304		
	Total	15.373	41			

Significant differences are observed in digital transformation perceptions ($F = 4.892$, $p = 0.006$) and IT infrastructure efficiency assessments ($F = 4.187$, $p = 0.012$) across job levels. Post-hoc Tukey tests (not shown in full) reveal that senior and middle management employees rate both digital transformation and infrastructure efficiency significantly higher than operational staff, a pattern consistent with Zhang et al.'s (2023) finding that top management engagement is a critical driver of digital transformation perception and effectiveness.

Table 10: Mean Scores by Job Level – Digital Transformation and IT Infrastructure Efficiency

Job Level	DT Mean	DT SD	Efficiency Mean	Efficiency SD
Operational Staff (n=18)	3.62	0.651	3.64	0.638
Supervisor/Team Leader (n=13)	3.74	0.622	3.79	0.612
Middle Management (n=8)	3.91	0.571	3.94	0.584
Senior Management (n=3)	4.13	0.481	4.18	0.512

The progressive increase in both digital transformation and efficiency scores from operational staff to senior management (3.62 to 4.13 for DT; 3.64 to 4.18 for efficiency) as seen in Table 10 reflects the well-documented pattern in which senior organizational members, who have greater visibility into strategic initiatives and broader organizational perspectives, tend to perceive digital transformation investments more positively and attribute higher efficiency gains to them (Wu et al., 2024; Yu et al., 2022).

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

5. Discussion

5.1 Interpreting the Main Findings

The central finding of this study that digital transformation is strongly and positively associated with IT infrastructure efficiency at ARAK is robust across multiple dimensions of both constructs and is supported by high levels of statistical significance and large effect sizes. The correlation of $r = 0.812$ between overall digital transformation and overall IT infrastructure efficiency, and the R^2 of 0.758 in the regression analysis, indicate that digital transformation explains a large proportion of the variance in infrastructure efficiency within this organizational context. These findings are highly consistent with the empirical evidence accumulated in the international literature (Beitelmal & Alruwaythi, 2025; Zhang et al., 2022; Yu et al., 2022; Zhai et al., 2022).

The prominence of operational integration as the strongest predictor of efficiency ($\beta = 0.362$) deserves particular attention. This finding aligns with the arguments of Muhajji et al. (2024) and Tebenko et al. (2024), who emphasize that digital technologies must be genuinely embedded within organizational workflows to generate efficiency improvements, rather than being adopted as standalone tools. For ARAK, this suggests that the organization's investments in operational digitalization are yielding meaningful returns in terms of infrastructure efficiency.

The finding that digital strategy alignment is the second most powerful predictor of efficiency ($\beta = 0.301$) is equally important and resonates strongly with the theoretical arguments advanced by Zhang, Xu, and Ma (2023) and Halim, Kesuma, and Siregar (2023). The practical implication is clear: at ARAK, the coherence and quality of the organization's digital transformation strategy constitute a critical lever for infrastructure efficiency improvement. The relatively smaller effect of sustainability orientation on efficiency ($\beta = 0.198$), while still statistically significant, reflects the relatively early stage of sustainability integration in ARAK's digital transformation journey. This is consistent with the broader literature finding that sustainability benefits of digital transformation tend to materialize in the more advanced stages of organizational digital

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

maturity (Alojail & Khan, 2023; Kwilinski et al., 2023; Liu et al., 2025).

5.2 The Innovation Efficiency Nexus

The finding that innovation capacity and service delivery performance are the efficiency dimensions most strongly predicted by overall digital transformation (both $R^2 \approx 0.61$) while cost optimization is the least strongly predicted ($R^2 = 0.524$) aligns with the pattern identified by Beitelmal and Alruwaythi (2025), who observe that digital transformation first generates improvements in service quality and reliability before realizing its full potential for cost reduction. This temporal pattern implies that ARAK can expect to realize increasingly significant cost optimization benefits as its digital transformation journey matures.

5.3 Practical Implications for ARAK

The findings of this study have several important practical implications for ARAK's digital transformation strategy. The strong performance on technology adoption and operational integration dimensions indicates that the organization's investments in these areas have been productive and should be sustained. However, the gap between technological capability and strategic alignment suggests that ARAK would benefit from investing more systematically in the strategic governance of its digital transformation. The relatively modest performance on sustainability orientation suggests an important opportunity for ARAK to differentiate itself within Libya's IT services market by positioning sustainability as a strategic pillar of its digital transformation agenda. Drawing on the frameworks provided by Kwilinski, Lyulyov, and Pimonenko (2023) and Mavlutova et al. (2022), the organization could develop explicit sustainability targets for its digital infrastructure.

6. Conclusions and Recommendations

6.1 Conclusions

This study has investigated the role of digital transformation in enhancing IT infrastructure efficiency at ARAK, using a quantitative survey of 42 employees and a comprehensive analytical framework drawn from the international literature. The findings

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

provide strong and consistent support for the hypothesis that digital transformation is positively and significantly associated with IT infrastructure efficiency across multiple dimensions of both constructs.

The study has demonstrated that operational integration emerges as the most powerful predictor of infrastructure efficiency, followed by digital strategy alignment, technology adoption, and sustainability orientation. All four digital transformation dimensions make statistically significant independent contributions to efficiency, and together they explain 75.8% of the variance in overall IT infrastructure efficiency. These findings confirm the central hypothesis of the study and contributes important empirical evidence to the literature on digital transformation in developing country contexts.

The study has also identified important patterns in the relative magnitudes of efficiency benefits, finding that innovation capacity and service delivery performance are the efficiency dimensions most strongly predicted by digital transformation, while cost optimization, though significantly predicted, shows the weakest association. This pattern is consistent with theoretical frameworks suggesting that cost reduction benefits materialize most fully at advanced stages of digital maturity, and implies that ARAK can anticipate continued and growing cost optimization benefits as its digital transformation journey progresses.

Several important caveats should be noted. The study relies on self-reported perceptual data from a single organization, which limits both the objectivity of the efficiency measures and the generalizability of the findings. Future research should seek to incorporate objective performance data and to examine digital transformation-efficiency relationships across multiple organizations in the Libyan and broader regional context.

7. References

Alojail, M., & Khan, S. B. (2023). Impact of digital transformation toward sustainable development. *Sustainability*, 15(9), 7210.



The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

- Beitelmal, W., & Alruwaythi, O. (2025). Exploring the benefits of digital transformation (DT) for infrastructure asset management (IAM) in terms of efficiency, cost savings, and performance optimization. *Arabian Journal for Science and Engineering*. Springer.
- Chen, P., & Kim, S. K. (2023). The impact of digital transformation on innovation performance: The mediating role of innovation factors. *Heliyon*, 9(4), e15123.
- Halim, H., Kesuma, T. M., & Siregar, M. R. (2023). Digital transformation strategy to optimize company performance. *Jurnal Manajemen Bisnis dan Kewirausahaan*, 7(2), 115–128.
- Hendrawan, S. A., Chatra, A., & Iman, N. (2024). Digital transformation in MSMEs: Challenges and opportunities in technology management. *Jurnal Informasi dan Teknologi*, 6(1), 1–14.
- Kwilinski, A., Lyulyov, O., & Pimonenko, T. (2023). Unlocking sustainable value through digital transformation: An examination of ESG performance. *Information*, 14(6), 321.
- Liu, G., Su, X., Zhu, Z., Ge, W., & Ran, Q. (2025). The path to green efficiency: The critical role of digital infrastructure in industrial upgrading and environmental sustainability. *Journal of Environmental Management*, 365, 120345.
- Martínez-Peláez, R., Ochoa-Brust, A., Rivera, S., Félix, V. G., & Colleagues. (2023). Role of digital transformation for achieving sustainability: Mediated role of stakeholders, key capabilities, and technology. *Sustainability*, 15(4), 3256.
- Muhajji, M., Rappe, A., Halim, M. R., & Colleagues. (2024). The role of technology and infrastructure in improving operational efficiency. *Bata Ilyas Educational Management Review*, 3(2), 101–112.
- Nambisan, S., Lyytinen, K., Majchrzak, A., & Song, M. (2017). Digital innovation management: Reinventing innovation management research in a digital world. *MIS Quarterly*, 41(1), 223-238.

The Role of Digital Transformation in Enhancing IT Infrastructure
Efficiency: An Applied Study on ARAK – Communication & IT
Services Libya

<http://www.doi.org/10.62341/istj-vol39-1-kj38>

- Shostak, L., Goi, V., Timchenko, O., & Yastrubetska, L. (2023). The impact of digital transformation on the economy: Technological innovation and efficiency. *Economic Studies Journal*, 32(4), 45–60.
- Tebenko, V., Kutsai, N., Shashyna, M., Omelianenko, O., & Colleagues. (2024). Digital transformation in business: The impact of technology on efficiency, innovation and competitiveness. *Proceedings of Economic Development Studies*, 18(3), 55–67.
- Wu, Y., Li, H., Luo, R., & Yu, Y. (2024). How digital transformation helps enterprises achieve high-quality development? Empirical evidence from Chinese listed companies. *European Journal of Innovation Management*, 27(3), 745–763.
- Yu, J., Wang, J., & Moon, T. (2022). Influence of digital transformation capability on operational performance. *Sustainability*, 14(18), 11567.
- Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *The Journal of Strategic Information Systems*, 28(2), 118-144.
- Zhai, H., Yang, M., & Chan, K. C. (2022). Does digital transformation enhance a firm's performance? Evidence from China. *Technology in Society*, 68, 101841.
- Zhang, T., Shi, Z. Z., Shi, Y. R., & Chen, N. J. (2022). Enterprise digital transformation and production efficiency: Mechanism analysis and empirical research. *Economic Research–Ekonomiska Istraživanja*, 35(1), 2235–2254.
- Zhang, X., Xu, Y. Y., & Ma, L. (2023). Information technology investment and digital transformation: The roles of digital transformation strategy and top management. *Business Process Management Journal*, 29(6), 1452–1470.