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DIGITAL TRANSFORMATION AND THE MODERNIZATION OF LOCAL PUBLIC FACILITIES MANAGEMENT: EVIDENCE FROM TLEMCEN PROVINCE, ALGERIA

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Abstract. *This study examines how digital transformation contributes to modernizing the management of local public facilities in Tlemcen Province, Algeria. Despite increasing attention to digitalization, limited research addresses the key enablers of its success in local governance. Based on data from 273 public sector employees that were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) via Smart PLS, the study finds that human, physical, legal, and security requirements positively influence digital transformation. In turn, digital transformation significantly improves the efficiency, responsiveness, and quality of public facility management. The results underscore the need for strategic resource integration and institutional readiness. This research adds empirical evidence from Algeria and offers insights for policy and reform in developing countries.*

Keywords: *digital transformation, public facilities, PLS-SEM, Algeria*

Reikšminiai žodžiai: *Skaitmeninė transformacija; viešosios įstaigos; valdymo modernizavimas; PLS-SEM; Alžyras.*

JEL classification*: *H83, O33, H76

Introduction

Digital transformation represents a strategic shift involving the integration of digital

technologies across all public facility management functions, aligning stakeholders with the demands of the digital economy (Bondar et al. 2017). It relies on data exchange, advanced analytics, and algorithmic evaluation to enhance decision-making within interconnected systems. In the public sector, this shift incorporates tools such as social media, mobile platforms, and big data analytics to foster more efficient governance and increased public value (Fitzgerald et al. 2013; Verhoef et al. 2021). Empirical studies confirm that digital service delivery strengthens transparency, performance, and service quality (Kraus et al. 2022). Globally, digitalization has become central to public sector reform, especially at the local level (Mergel et al. 2019). Emerging technologies such as the Internet of Things (IoT) and big data facilitate real-time monitoring and resource optimization, leading to reduced costs and improved effectiveness (Atta and Talamo 2020; Naji et al. 2024; Erhueh et al. 2024). Accordingly, digital transformation is now considered a strategic obligation, requiring a shift from traditional metrics to broader capability-based management systems (Amaratunga and Baldry 2002; Marks and AL-Ali 2020). Recent research highlights the importance of digital frameworks and smart reporting systems in sectors such as education, healthcare, and finance for accelerating responses and reducing inefficiencies (Santos et al. 2024; Yadav 2024). At the local level, digital transformation contributes to better governance and more equitable access to services, helping address disparities between urban and rural areas (Omweri 2024). However, challenges remain, including resistance to change and insufficient infrastructure, emphasizing the need for strong readiness models tailored for local administrations (Aristovnik et al. 2024; Novienty and Febiayu 2025; Akbar et al. 2025). This study investigates (1) how critical prerequisites—human resources, infrastructure, legal frameworks, and information security—affect digital transformation implementation, and (2) how this transformation improves local governance in public facility management. Using data from five sectors in Tlemcen Province, it applies the PLS-SEM approach to explore causal relationships and inform digital governance reforms, supported by a literature review, conceptual framework, methodology, and empirical findings with practical implications.

1. Literature Review and Hypotheses

Recent literature highlights the growing importance of digital transformation in improving the management of local public facilities and how it enhances service quality, resource efficiency, and citizen engagement. In their studies, Latupeirissa et al. (2024) and Das (2024) demonstrate that smart governance initiatives and targeted technological investments—such as Smart Villages—can significantly improve service delivery at the community level. However, persistent challenges such as urban-rural infrastructure gaps and risks of digital exclusion remain significant (Omweri 2024; Sampetoding and Mahendrawathi 2024). Sectoral applications, including healthcare and education, illustrate how

digital tools (e.g., artificial intelligence and Internet of Medical Things) and smart systems improve operational efficiency and transparency (Iyamu et al. 2021; Hameed et al. 2024; Benavides et al. 2020). Building on this foundation, the study proposes:

H1: Digital Transformation Applications have a significant positive effect on the management of local public facilities.

Human competencies are key to digital transformation success. Training, adaptability, and leadership support have been repeatedly emphasized. Noe (2009) highlighted the value of adult learning in skill development, while Berman (2012) emphasized the need for adaptability and technical skills. Leadership vision and support also enhance digital innovation (Schiuma et al. 2024), especially in key sectors such as health and education. Continuous capacity building remains crucial for public institutions, especially at the local level (Paul et al. 2024).

H2: Human Requirements (competencies and training) have a significant positive effect on Digital Transformation Applications in local public facilities.

Physical infrastructure is another foundational pillar. The adoption of technologies such as IoT and cloud computing depends on reliable systems aligned with institutional objectives (Nagy et al. 2018; Bharadwaj et al. 2013). Despite the enabling potential of digital infrastructure, many institutions still face constraints due to outdated systems and insufficient funding (Das 2024; Naji et al. 2024). Addressing these issues requires strategic reforms and technological modernization.

H3: Physical Requirements (infrastructure and equipment) have a significant positive effect on Digital Transformation Applications in local public facilities.

Legal and administrative frameworks underpin successful digital transitions by providing regulatory clarity and institutional support. Effective governance depends on laws that foster accountability and transparency (Mergel et al. 2019) and a shift in institutional culture (Ciancarini et al. 2024). Forradellas et al. (2021) emphasized the importance of coherent legal structures in sustaining digital change, while Fang (2002) noted how e-government has already reshaped public administration practices.

H4: Legal and Administrative Framework (legislation and regulations) has a significant positive effect on Digital Transformation Applications in local public facilities.

Information security is essential to ensure the credibility and continuity of digital transformation. As public services digitalize, risks such as data breaches and cyberattacks grow (Saeed et al. 2023). Weak cybersecurity can erode public trust and compromise systems (Stewart 2023). Hence, robust cybersecurity strategies aligned with institutional architecture are critical (Judijanto et al. 2023).

H5: Information Security (cybersecurity) has a significant positive effect on Digital Transformation Applications in local public facilities.

Drawing from these insights, this study builds a conceptual model to explore how key digital transformation requirements influence the modernization of local public facility management. Despite Algeria's growing focus on digital governance (Mokhtari 2024),

practical implementation remains challenged by institutional fragmentation, skill gaps, and resource constraints (Bouberka et al. 2023; Ratiba and Benamrouche 2024). Existing Algerian research tends to focus on national strategies or single sectors, neglecting local-level dynamics. Addressing this gap, the present study uses Tlemcen Province as a case study to investigate five key sectors—health, higher education, electricity and gas, municipalities, and tax administration—using PLS-SEM to analyze causal relationships and support evidence-based policy recommendations.

2. Methods

2.1 Sample and Data Collection Procedures

In Algeria, local governments—particularly provinces and municipalities—are central to public service delivery. Tlemcen Province was selected for its strategic importance and institutional diversity, reflecting national public management dynamics. The study focused on five key institutions: the University Hospital Center, the University of Tlemcen, the Municipality of Tlemcen, Sonelgaz's provincial branch, and the Directorate of Taxation, covering the sectors of healthcare, education, municipal services, energy, and finance. A purposive sampling approach was used to target individuals directly involved in digital transformation efforts, with participation being voluntary and purpose-driven. The final sample consisted of 273 respondents: 50 from the University Hospital, 48 from the university, 35 from the municipality, 81 from Sonelgaz, and 59 from the tax directorate, ensuring a balanced representation across critical public sectors.

2.2 Measures

To achieve the study's objectives and based on the literature review and research hypotheses, a structured, closed-ended questionnaire was used as the main data collection tool. It included three sections: (1) demographic variables, gathering data on gender, age, education, and professional experience; (2) the independent variable—digital transformation—measured across four core dimensions, i.e., Human Requirements (competencies and training), Physical Requirements (infrastructure and equipment), Legal and Administrative Framework (laws and regulations), and Information Security (cybersecurity), using 20 statements (five per dimension); and (3) the dependent variable—modernization of public facility management—assessed through eight statements related to administrative development and service improvement. The final questionnaire included 28 positively worded items measured on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). It was administered during field visits to selected institutions, with voluntary participation, over a four-month period to ensure comprehensive data collection and reliable responses.

2.3 Data Analysis Methods

Descriptive statistics (frequencies and percentages) were used via Microsoft Excel to analyze demographic data such as gender, age, education, and professional experience. To examine the relationships among key variables, the study employed PLS-SEM using Smart PLS 4.0. This method was chosen for its suitability with small sample sizes, complex models, and non-normal data (Wong 2013; Hair et al. 2014a), making it appropriate for analyzing the impact of digital transformation on the modernization of local public facility management. The analysis followed three stages: (1) the measurement model was evaluated using outer loadings, Cronbach's alpha, composite reliability, and average variance extracted (AVE) for convergent validity and the Fornell-Larcker criterion for discriminant validity; (2) the structural model was assessed through R^2 (explanatory power), Q^2 (predictive relevance), and f^2 (effect size) (Hair et al. 2014b); and (3) hypothesis testing was conducted using bootstrapping to determine the significance and strength of path coefficients. This method is widely adopted in public administration research due to its accuracy in handling complex relationships.

3. Findings

3.1 Demographic Characteristics of the Respondents

Table 1 presents the demographic characteristics of the 273 respondents. Males accounted for 60.07% and females 39.93%, indicating a gender distribution skewed slightly toward males. Most participants were between 30 and 49 years old, reflecting mid-career professionals with relevant experience. About 48.72% held a bachelor's degree, while 36.85% had postgraduate or professional qualifications, indicating a well-educated sample. Additionally, 60.81% had more than 10 years of professional experience, which strengthens the credibility and depth of their insights into institutional practices and digital transformation.

Table 1. Respondents' Demographic Variables (N = 273)

Demographic variable	Category	Frequency	%
Gender	Male	164	60.07
	Female	109	39.93
Age (years)	20–30	32	11.72
	30–40	108	39.56
	40–50	88	32.23
	50+	45	16.49

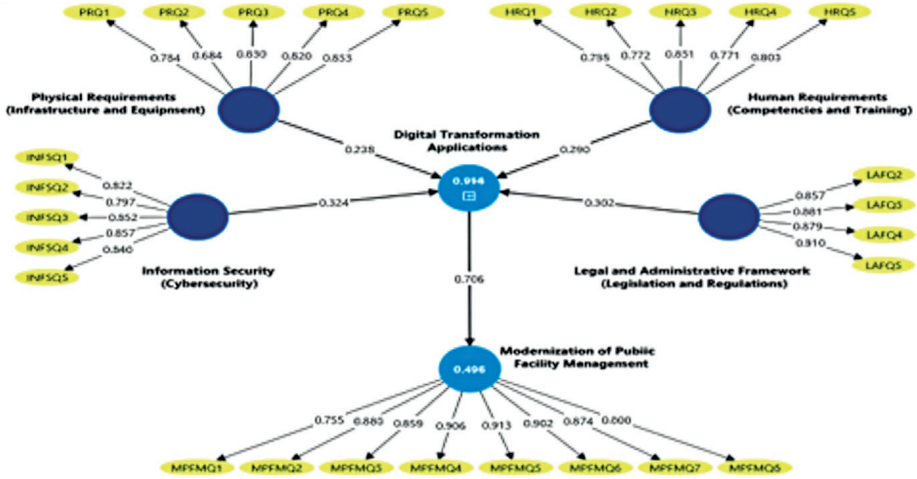
Educational level/Professional field	Bachelor's	133	48.72
	Engineering	40	14.65
	Master's	69	25.27
	Doctorate	08	2.93
	Doctor	11	4.03
	Paramedic	12	4.40
Professional experience (years)	5-	29	10.62
	5–10	78	28.57
	10–15	82	30.04
	15+	84	30.77

Source: Authors, based on survey data

3.2 Measurement Model Evaluation

Within the PLS-SEM framework, most indicators in Figure 1 displayed outer loadings above 0.70, confirming measurement reliability. One item from the Legal and Administrative Framework was removed due to low loading and minimal impact on the AVE. An item from the Physical Requirements construct, although slightly below 0.70, was retained for theoretical and statistical reasons. Overall, the results support the model's convergent validity and reliability.

Figure 1. Outer Loadings of Measurement Items for Each Construct



Source: Author's computation using SMART PLS.4 software

Construct reliability and validity were confirmed through Table 2. Cronbach's alpha and composite reliability values exceeded 0.70, indicating strong internal consistency (Fornell and Larcker 1981; Hair et al. 2014b). Convergent validity was supported by AVE values above 0.50 (Hair et al. 2014a). Discriminant validity, verified using the Fornell-Larcker criterion, showed that the square root of each AVE was greater than inter-construct correlations, confirming distinctiveness (Fornell and Larcker 1981).

Table 2. Reliability and Validity of Constructs

Reliability and AVE						
Construct	Cronbach's alpha		Composite reliability		AVE	
DTA	0.943		0.945		0.510	
HR	0.846		0.847		0.619	
INFS	0.890		0.893		0.695	
LAF	0.879		0.882		0.735	
PR	0.851		0.865		0.627	
MPFM	0.951		0.955		0.746	
Discriminant Validity (Fornell-Larcker)						
	DTA	HR	INFS	LAF	PR	MPFM
DTA	0.714					
HR	0. 787	0.859				
INFS	0.834	0.632	0.874			
LAF	0.857	0.639	0.726	0.878		
PR	0.792	0.719	0.622	0.653	0.845	
MPFM	0.706	0.598	0.583	0.686	0.541	0.864
Note. DTA, Digital Transformation Applications; HR, Human Requirements; INFS, Information Security; LAF, Legal and Administrative Framework; PR, Physical Requirements; MPFM, Modernization of Public Facility Management						

Source: Author's computation using SMART PLS.4 software

3.3 Structural Model Evaluation

The structural model was assessed using R^2, Q^2predict, and f^2 to evaluate explanatory power, predictive relevance, and effect sizes (Hair et al. 2017). As shown in Table 3, R^2 for Digital Transformation Applications was 0.998, and for Public Facility Management Modernization it was 0.498—indicating high and moderate explanatory power, respectively.

Adjusted R^2 values (0.998 and 0.496) confirmed the model's robustness. Q^2predict values of 0.998 and 0.481 exceeded zero, supporting strong predictive relevance (Stone 1974).

Table 3. Explanatory and Predictive Power of the Structural Model

	R^2	R^2 adjusted	Q^2predict
Digital Transformation Applications	0.998	0.998	0.998
Modernization of Public Facility Management	0.498	0.496	0.481

Source: Author's computation using SMART PLS.4 software

Effect sizes (f^2) were examined to assess the strength of relationships between variables. As shown in Table 4, all predictors had strong effects (Hair et al. 2017). Information Security had the largest impact on Digital Transformation Applications (f^2 = 28.742), followed by Legal and Administrative Framework (23.627), Human Requirements (22.872), and Physical Requirements (15.331). The effect of Digital Transformation Applications on Public Facility Management Modernization was also significant (f^2 = 0.992), confirming the structural model's robustness.

Table 4. Effect Sizes (f^2) of the Structural Model Relationships

	f^2
Digital Transformation Applications -> Modernization of Public Facility Management	0.992
Human Requirements -> Digital Transformation Applications	22.872
Information Security-> Digital Transformation Applications	28.742
Legal and Administrative Framework -> Digital Transformation Applications	23.627
Physical Requirements -> Digital Transformation Applications	15.331

Source: Author's computation using SMART PLS.4 software

3.4 Hypothesis Testing Using the Bootstrapping Procedure

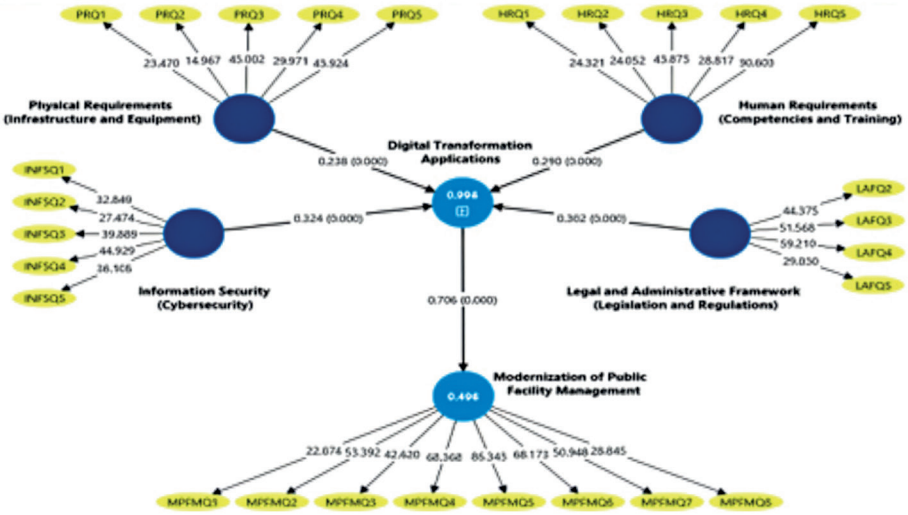
Hypothesis testing was conducted using bootstrapping with 5,000 samples in Smart PLS. As shown in Table 5, all five hypotheses were statistically supported, with T-values > 1.96 and p-values < 0.001. Digital Transformation Applications (DTA) had a strong positive effect on Public Facility Management Modernization (MPFM) (H1). Human Requirements, Physical Requirements, Legal and Administrative Framework, and Information Security significantly influenced DTA (H2–H5). These findings confirm the theoretical model, with Figure 2 illustrating the strength and direction of all relationships.

Table 5. Results of Hypothesis Testing

Hypotheses	Original sample (O)	Sample mean (M)	Standard deviation	T statistics (|O/STDEV|)	P-values	Conclusion
H1: DTA -> MPFM	0.706	0.707	0.043	16.300	0.000	H1 is accepted
H2: HR -> DTA	0.290	0.290	0.011	26.888	0.000	H2 is accepted
H3: PR -> DTA	0.238	0.238	0.010	23.302	0.000	H3 is accepted
H4:LAF -> DTA	0.302	0.302	0.012	24.652	0.000	H4 is accepted
H5: INFS -> DTA	0.324	0.324	0.014	23.613	0.000	H5 is accepted
Note. DTA, Digital Transformation Applications; HR, Human Requirements; INFS, Information Security; LAF, Legal and Administrative Framework; PR, Physical Requirements; MPFM, Modernization of Public Facility Management						

Source: Author's computation using SMART PLS.4 software

Figure 2. Final Structural Model Results with Path Coefficients and Significance Levels



Source: Author's computation using SMART PLS.4 software

4. Discussion and Conclusion

The empirical results validate all five hypotheses, confirming that digital transformation significantly enhances the management of local public facilities. This effect is reinforced by

the availability of key enablers: human competencies, physical infrastructure, legal-administrative frameworks, and information security.

The positive influence of human requirements aligns with prior research emphasizing the importance of digital skills, training, and leadership in public sector innovation (Noe 2009; Berman 2012; Paul et al. 2024). Similarly, the role of infrastructure confirms that technological readiness—through ICT equipment and connectivity—is a foundational element for effective digitalization (Bharadwaj et al. 2013; Das 2024). Legal and institutional frameworks also emerged as critical, supporting findings that regulatory coherence and adaptive governance structures are essential for sustaining transformation (Mergel et al. 2019; Forradellas et al. 2021). Moreover, the confirmed impact of cybersecurity highlights its strategic value in safeguarding digital systems and maintaining citizen trust (Saeed et al. 2023; Judijanto et al. 2023).

In light of these findings, the following points summarize the main conclusions of the study and highlight their implications.

1. This study confirms that digital transformation serves as a catalyst for modernizing the management of local public facilities, leading to improvements in service quality, operational efficiency, and citizen engagement, particularly at the local level where its effects are most tangible. The findings provide empirical support for the proposed conceptual model and contribute to addressing the limited Algerian literature on digital transformation in local public administration.
2. The results indicate that successful digital transformation is not merely a technical endeavor but a strategic process that requires coordinated investment in human resources, digital infrastructure, legal and administrative frameworks, and cybersecurity. These insights offer practical implications for public policymakers and local decision-makers seeking to enhance service delivery and institutional performance in Algeria and similar developing-country contexts.
3. Despite its contributions, this study has certain limitations. The empirical analysis is limited to Tlemcen Province, which may restrict the generalizability of the findings to other regions. In addition, the use of cross-sectional data does not allow for capturing dynamic changes over time. Future research could extend the analysis to multiple provinces, adopt longitudinal research designs, or conduct comparative studies to provide a more comprehensive understanding of digital transformation in the management of local public facilities.

Data Availability Statement

The data used to support the findings of this research are available from the corresponding authors upon request.

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SKAITMENINĖ TRANSFORMACIJA IR LOKALINIŲ VIEŠŲJŲ ĮSTAIGŲ VALDYMO MODERNIZAVIMAS: ĮRODYMAI IŠ ALŽYRO TLEMCEN PROVINCIJOS

Santrauka. Šiame tyrime nagrinėjama, kaip skaitmeninė transformacija prisideda prie lokalinių viešųjų įstaigų valdymo modernizavimo Tlemcen provincijoje, Alžyre. Nepaisant didėjančio dėmesio skaitmeninimui, nedaug tyrimų nagrinėja pagrindinius jo sėkmės veiksnius vietos valdyme. Remiantis 273 viešojo sektoriaus darbuotojų duomenimis ir analize naudojant PLS-SEM per „Smart PLS", tyrime nustatyta, kad žmogiškieji, fiziniai, teisiniai ir saugumo reikalavimai teigiamai veikia skaitmeninę transformaciją. Savo ruožtu skaitmeninė transformacija žymiai pagerina viešųjų įstaigų valdymo efektyvumą, reagavimą ir kokybę. Rezultatai pabrėžia strateginės išteklių integracijos ir institucinio pasirengimo poreikį. Šis tyrimas papildo empirinius duomenis iš Alžyro ir pateikia įžvalgų dėl politikos ir reformų įgyvendinimo besivystančiose šalyse.

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