

Article type:
Original Research

Article history:
Received 05 March 2026
Revised 24 April 2026
Accepted 15 June 2026
Initial Publish 29 June 2026
Published online 01 January 2027

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How to cite this article:
Paydar, Z., Pourabrahimi, A., Afshar Kazemi, M. A., & Amin Mousavi, S. A. (2027). Smart Maturity Model for the Digital Transformation Capability of Urban Management Organizations: A Thematic Analysis Approach. *Future of Work and Digital Management Journal*, 5(1), 1-23.
<https://doi.org/10.61838/fwdmj.275>



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Smart Maturity Model for the Digital Transformation Capability of Urban Management Organizations: A Thematic Analysis Approach

ABSTRACT

The purpose of this study was to develop a smart maturity model for the digital transformation capability of urban management organizations. From a philosophical perspective, the study was conducted within the interpretivist paradigm and followed an inductive approach. This research is classified as a qualitative study. A total of 21 semi-structured interviews were conducted with university faculty members in management disciplines who had research experience or collaboration experience with urban management organizations, as well as senior managers and experts from municipalities, waste management organizations, fire departments, transportation and traffic organizations, and Islamic City Councils. Participants held at least a master's degree and possessed more than 15 years of professional experience. They were selected using purposive non-probability sampling. Based on the principle of theoretical saturation, saturation was achieved during the eighteenth interview. The required data were collected through semi-structured interviews, and data analysis was carried out using the thematic analysis method proposed by Braun and Clarke (2006). The data analysis process resulted in the identification of 7 overarching themes, 29 organizing themes, and 113 basic themes. The findings indicate that successful digital transformation in urban management organizations requires an integrated and holistic approach emerging from the interaction of seven key dimensions: human, technical, strategic, process, environmental, governance, and ecosystem dimensions. The proposed maturity model provides a comprehensive framework for assessing, planning, and implementing digital transformation, emphasizing strong governance, stakeholder engagement, and the alignment of technology with sustainable urban missions. These findings not only offer a comprehensive understanding of the smart maturity model for digital transformation capability but also contribute to the advancement of the information technology management literature.

Keywords: Smart Maturity Model, Digital Transformation Capability, Urban Management Organizations, Thematic Analysis.

Introduction

Digital transformation has emerged as one of the most significant paradigmatic shifts in contemporary public management and urban governance. The rapid expansion of digital technologies, including cloud computing, big data analytics, artificial intelligence, the Internet of Things, digital platforms, and advanced communication infrastructures, has fundamentally altered how organizations create value, manage resources, and interact with stakeholders. In the context of urban management, digital transformation extends beyond the simple adoption of technological tools and represents a comprehensive process of organizational, managerial, cultural, and strategic change aimed at enhancing efficiency, sustainability, transparency, and citizen-centered service delivery [1-3]. As cities confront increasing population growth, environmental challenges, infrastructure complexity, and rising citizen expectations, urban management organizations are

under mounting pressure to adopt digital solutions capable of supporting smarter, more resilient, and sustainable governance systems [4-6].

The concept of smart cities has significantly contributed to the growing importance of digital transformation in urban management. Smart cities are characterized by the integration of digital technologies into urban systems to improve public services, optimize resource utilization, strengthen governance mechanisms, and enhance the quality of life for citizens. However, the success of smart city initiatives depends not only on technological investments but also on the organizational capabilities required to manage and sustain digital transformation processes effectively [1, 2, 7]. Research has increasingly demonstrated that technological deployment without corresponding organizational readiness often results in fragmented initiatives, inefficient resource allocation, and limited transformation outcomes. Therefore, urban management organizations must develop comprehensive digital transformation capabilities that encompass technological, organizational, human, strategic, and governance dimensions [8-10].

In recent years, municipalities and urban management organizations worldwide have accelerated their digital transformation agendas. The experiences of leading cities have demonstrated the potential of digital technologies to improve service delivery, enhance operational efficiency, facilitate evidence-based decision-making, and strengthen citizen engagement. Municipal digital platforms, intelligent transportation systems, smart infrastructure monitoring, and integrated urban data ecosystems are increasingly becoming essential components of modern urban governance [5, 11, 12]. Nevertheless, substantial disparities remain among cities regarding their ability to successfully implement and sustain digital transformation initiatives. These disparities often stem from differences in organizational maturity, leadership commitment, technological infrastructure, governance frameworks, and workforce capabilities [6, 13, 14].

The notion of digital transformation capability has consequently attracted growing scholarly attention. Digital transformation capability refers to an organization's capacity to strategically adopt, integrate, manage, and leverage digital technologies to achieve sustained organizational transformation and value creation. This capability encompasses a broad range of competencies, including technological readiness, strategic alignment, organizational learning, leadership support, innovation management, stakeholder engagement, and adaptive governance structures [9, 15, 16]. Unlike isolated technology implementation projects, digital transformation capability emphasizes the organization's holistic ability to continuously evolve and respond to technological and environmental changes.

The development of digital transformation capability is particularly critical in urban management organizations because of the multidimensional nature of municipal services and governance responsibilities. Urban management organizations operate within highly complex environments characterized by numerous stakeholders, interconnected systems, diverse service portfolios, and increasing accountability requirements. As a result, successful digital transformation requires coordination across multiple organizational functions and governance levels [7, 8, 17]. Municipalities must simultaneously address issues related to technological modernization, workforce development, regulatory compliance, data governance, citizen participation, sustainability, and ecosystem collaboration.

Within this context, maturity models have emerged as valuable instruments for assessing organizational readiness and guiding transformation efforts. Maturity models provide structured frameworks that enable organizations to evaluate their current capabilities, identify developmental gaps, and formulate improvement roadmaps. Originally developed in the field of software engineering, maturity models have gradually expanded into various organizational domains, including digital

transformation, innovation management, organizational development, and public administration [18-20]. These models help organizations understand their current position relative to desired future states and support systematic progression through increasingly sophisticated levels of capability development.

Digital transformation maturity models have become increasingly important as organizations seek to navigate complex transformation journeys. Existing studies suggest that organizations with higher levels of digital maturity demonstrate greater agility, innovation capacity, operational efficiency, and stakeholder responsiveness than their less mature counterparts [18-20]. Consequently, maturity assessment has become an essential component of digital transformation planning and governance. However, many existing maturity models have been developed for private-sector organizations and may not fully capture the unique characteristics and requirements of urban management organizations.

Several studies have attempted to address this gap by developing digital transformation maturity models specifically for municipalities and smart cities. The Smart City Digital Transformation Capability Maturity Model (SC-DT-CMM) proposed by Aboutalebi and Ajoudanian represents one of the pioneering efforts in this area [21]. Subsequent research further refined these concepts by proposing process-aware digital transformation maturity models tailored to smart city environments [22]. Similarly, studies conducted in Iranian municipalities have identified various dimensions of digital transformation maturity and proposed frameworks for assessing municipal readiness and capability development [23-25].

Despite these advances, significant theoretical and practical challenges remain. Existing maturity models often emphasize technological infrastructure while paying insufficient attention to critical dimensions such as governance, organizational culture, ecosystem collaboration, sustainability, and citizen engagement. Furthermore, many models have been developed using quantitative approaches and predefined constructs, limiting their ability to capture context-specific factors influencing digital transformation in urban management organizations [10, 26, 27]. Given the complexity of municipal environments, there is a growing need for comprehensive and contextually grounded maturity frameworks capable of reflecting the multifaceted nature of digital transformation capability.

Another important consideration is the growing recognition that digital transformation is not solely a technological phenomenon but rather a socio-technical and organizational process. Research has demonstrated that human factors, including leadership, organizational culture, employee competencies, and change readiness, play decisive roles in determining transformation outcomes [26, 28, 29]. Digital capabilities embedded within the workforce and organizational culture significantly influence the success of digital initiatives. Moreover, digital citizenship, stakeholder participation, and collaborative innovation ecosystems increasingly contribute to sustainable transformation outcomes [1, 2, 29].

The importance of governance mechanisms has also become increasingly evident. As municipalities collect and process growing volumes of urban data, issues related to data governance, privacy protection, cybersecurity, ethical technology use, and regulatory compliance have gained prominence. Effective governance structures are necessary to ensure that digital transformation initiatives remain aligned with organizational objectives, societal values, and legal requirements [6, 7, 14]. Digital governance has therefore emerged as a critical dimension of organizational maturity within urban management contexts.

Furthermore, the sustainability implications of digital transformation have attracted increasing attention from both researchers and practitioners. Digital technologies can contribute significantly to environmental sustainability, resource optimization, and improved urban resilience. However, achieving these benefits requires strategic integration of

sustainability considerations into digital transformation planning and implementation processes [3, 4, 27]. Consequently, maturity models must account for the broader environmental and societal impacts of digital transformation rather than focusing exclusively on operational efficiency.

The role of infrastructure also remains fundamental to digital transformation capability. Advanced digital services depend upon robust communication networks, integrated information systems, interoperable platforms, and reliable data infrastructures. Studies have consistently demonstrated the importance of digital infrastructure as a foundational enabler of transformation efforts [17, 20, 30]. Nevertheless, infrastructure alone is insufficient without complementary organizational capabilities that support effective technology utilization and innovation.

In addition to internal organizational factors, external ecosystem dynamics substantially influence digital transformation outcomes. Contemporary urban innovation increasingly depends upon collaboration among municipalities, technology firms, universities, startups, civic organizations, and citizens. Digital ecosystems facilitate knowledge sharing, innovation diffusion, resource mobilization, and co-creation processes that enhance transformation effectiveness [1, 2, 12]. Therefore, maturity models that fail to consider ecosystem relationships may provide incomplete assessments of organizational capability.

The Iranian urban management context presents additional complexities and opportunities for digital transformation. Municipalities across Iran have initiated various smart city and digital government projects; however, implementation outcomes remain uneven. Challenges related to organizational readiness, technological integration, governance structures, workforce development, and strategic coordination continue to affect transformation efforts [14, 21, 23]. Consequently, there is a pressing need for contextually relevant frameworks capable of guiding municipalities through systematic capability development processes.

Although previous studies have identified various dimensions of digital transformation maturity and proposed conceptual frameworks for municipalities, a comprehensive smart maturity model that integrates human, technical, strategic, process, environmental, governance, and ecosystem dimensions remains underdeveloped. Moreover, qualitative investigations capable of capturing expert perspectives and uncovering context-specific maturity factors are relatively limited in the existing literature [22, 24, 25]. Addressing this gap can contribute both to theoretical advancement and practical guidance for urban management organizations seeking to accelerate digital transformation.

Therefore, the present study aims to develop a smart maturity model for the digital transformation capability of urban management organizations through thematic analysis of expert perspectives and experiences

Methodology

The present study was designed using the Research Onion model of Saunders, Lewis, and Thornhill (2016). From the perspective of research philosophy, this study is situated within the interpretivist paradigm, and in terms of approach, it is inductive. This research is classified as a qualitative study. The strategy used in this research was a case study, and the study was conducted cross-sectionally. Semi-structured interviews were used to collect data, and data analysis was conducted using thematic analysis. In the next section, the process of data collection through semi-structured interviews and their analysis using thematic analysis will be described. Thematic analysis is one of the fundamental methods for analyzing qualitative data. This method provides the basic skills required for many qualitative analyses and is recognized as an effective tool for

identifying, analyzing, and interpreting patterns within qualitative data obtained from interviews or library sources. In fact, thematic analysis transforms scattered and diverse data into coherent and comprehensive information.

Accordingly, in the present study, with the aim of presenting a smart maturity model for the digital transformation capability of urban management organizations, 21 semi-structured interviews were conducted with university faculty members in management disciplines who had research experience or collaboration experience with urban management organizations (5 participants), as well as senior managers and experts from municipalities (7 participants), waste management organizations (3 participants), fire departments (2 participants), transportation and traffic organizations (2 participants), and Islamic City Councils (2 participants). The obtained data were examined using thematic analysis. The selection criteria included theoretical and practical knowledge in the field of management for academic experts, at least 15 years of work experience for managers, and the ability to provide perspectives on the research topic. The sampling method was purposive non-probability sampling. Therefore, data collection ideally continues until the point of saturation is reached; that is, when new data no longer show any considerable difference from previous data. In other words, when further efforts to collect data lead to diminishing returns, it can be ensured that the study has been conducted comprehensively. In this study, conducting 18 interviews was sufficient to reach the point of saturation.

In addition, the interviewees' opinions were used in extracting codes, categorizing them, and developing the indicators. Finally, in a meeting attended by 5 experts who were among the interviewees, the extracted indicators were approved by them, indicating confirmation of the results by the interviewees. Therefore, in addition to deep and prolonged engagement, interviewee validation was also used to control the validity of the research. Moreover, in this study, to examine reliability, the method of intra-thematic agreement between two coders was used. Accordingly, one person was invited to participate in the research as a research collaborator and coder. After preparing the coding instructions and coding guide, the necessary training on the research topic and coding procedure was provided to this person. Then, several interviews were given to the research collaborator for coding. In each interview, the codes that were similar from the perspective of both coders were identified as agreements, and dissimilar codes were identified as disagreements. Finally, the percentage of intra-thematic agreement was calculated using the following formula:

$$\text{Intra-thematic agreement percentage} = (\text{Number of agreements} \times 2) / (\text{Total number of codes}) = 82.3$$

The agreement coefficient obtained from the two coders was 82.3, indicating high agreement and consistency as well as an appropriate reliability coefficient. It should be noted that the main questions of the semi-structured interview protocol were developed based on the existing theoretical foundations and previous research as follows:

In your opinion, how can the current state of digital transformation in the municipality be described? Are we mostly witnessing "isolated and project-oriented initiatives" or "integrated and strategy-driven transformation"? What is the most objective evidence for this claim?

From your perspective, what are the most important criteria or dimensions that should be included in an indigenous digital transformation maturity model for municipalities? For example, culture, technology, data governance, and citizen participation. How should these dimensions be prioritized, and why?

Which successful domestic or international model or pattern, related to a specific city, can be used as a reference framework for assessing the digital maturity of our municipality? What are the most important adaptable lessons from that model for us?

In your opinion, in which area does the largest gap exist between the “current state” and the “desired state” of digital maturity in the municipality? For example, in “laws and regulations,” “human resource skills,” “infrastructure integration,” or “strategic thinking.” What is the main reason for this gap?

To objectively assess the maturity level in each dimension, what qualitative and quantitative indicators can be both measurable and meaningful and practical for urban managers? For example, what number or sign can be valid for assessing “citizen participation maturity”?

How can the output of this maturity model be used to extract an operational and step-by-step roadmap? In other words, after identifying the maturity level, what specific actions should be taken to move to the next level?

What are the most important organizational, technical, or political barriers that may hinder the implementation and operationalization of this maturity model? For example, internal resistance, lack of data, or absence of a single responsible authority. What are the ways to overcome these barriers?

What is the main value of establishing such a maturity model for the municipality and citizens? How can this model lead to better decision-making, more efficient resource allocation, and ultimately improvement in the quality of urban life?

For data analysis, the thematic analysis technique based on the model of Braun and Clarke (2006) was used with NVivo software.

Findings and Results

Since the purpose of the present study is to identify initial and in-depth ideas in order to develop theoretical patterns for future empirical research in the area of the smart maturity model for the digital transformation capability of urban management organizations, based on qualitative findings, thematic analysis was selected. In this research, the thematic analysis approach of Braun and Clarke (2006) was used within a six-phase process. This analysis involves continuous movement back and forth between the dataset, the coded dataset, and the analysis of the emerging data. The writing of the analysis begins from the first phase. In general, there is no single unique way to begin a study for thematic analysis.

Phase One: Familiarization with the Data

In order for the researcher to become familiar with the depth and breadth of the data content, it is necessary to immerse oneself in the data. Immersion in the data usually involves repeated reading and active reading, so that the researcher searches for meanings and patterns.

Phase Two: Generating Initial Codes

The second phase begins when the researcher has read the data and become familiar with them. This phase involves generating initial codes from the data. Codes represent features of the data that appear interesting from the analyst’s perspective. Coded data differ from the units of thematic analysis. Coding can be done manually or through software programs. In this phase, 203 initial codes were extracted from the interviews.

Table 1*The Labeling Process for Generating Initial Codes*

Interview Number	Interview Text	Extracted Codes
10M1	One of the key indicators in this model is the percentage of organizational positions whose job descriptions require specific digital skills. This indicator reflects the workforce's capability to deal with digital challenges and use modern information technology tools.	Percentage of organizational positions whose job descriptions require specific digital skills
7M2	The average completion time of five key service processes before and after digitalization clearly shows the positive effects of digital transformation on service efficiency and speed.	Average completion time of five key service processes before and after digitalization
5M3	The level of job satisfaction among information technology and data specialists in surveys is also important as an indicator of organizational health and employee motivation in achieving digital goals.	Level of job satisfaction among information technology and data specialists
8M5	The degree of delegation of authority to teams for testing and implementing digital solutions can help increase speed and efficiency in implementing digital transformation projects.	Degree of delegation of authority to teams for testing and implementing digital solutions
3M8	The utilized capacity of the data center and the bandwidth of the organization's main network indicate the technical infrastructure and the organization's ability to manage data and information.	Utilized capacity of the data center and bandwidth of the organization's main network
4M9	The rate of active or passive resistance to digital transformation projects, which can be tracked through data such as implementation delays, reduced work quality, or increased complaints, indicates the depth of change-related challenges in practice.	Rate of active or passive resistance to digital transformation projects
5M11	The percentage of successfully completed change projects that include digital components is an outcome-oriented indicator that shows the effectiveness of change management in achieving project objectives.	Percentage of successfully completed change projects that include digital components
5M12	The speed of employees' adaptation to new digital systems and processes, which can be measured by criteria such as time to reach initial productivity or reduction in user errors, reflects the organization's agility in absorbing and applying innovations.	Speed of employees' adaptation to new digital systems and processes
7M14	The percentage of employees holding valid technical and digital certificates and the score of employees' digital skills assessment in internal standardized tests are used. These two latter indicators respectively provide external and internal evidence of the real level of digital competencies available in the organization and reveal the gap between the training provided and proven skills.	Percentage of employees holding valid technical and digital certificates Score of employees' digital skills assessment in internal standardized tests

Phase Three: Searching for Selective Codes

This phase involves classifying different codes into selective codes and organizing all summaries of coded data. In fact, the researcher begins analyzing the codes and considers how different codes can be combined to form an overarching theme. In this phase, the researcher obtained 130 selective codes by eliminating incomplete or irrelevant codes as well as duplicate codes.

Phase Four: Theme Formation

The fourth phase begins when the researcher has generated a set of themes and reviews them. This phase consists of two stages: reviewing and refining, and shaping subthemes. In the first stage, the coded summaries are reviewed, and in the second stage, the validity of the subthemes in relation to the dataset is considered.

Table 2*Organizing Themes and Overarching Themes Forming the Model*

Overarching Themes	Organizing Themes	Basic Themes
Human	Digital competencies	Average hours of digital skills training per employee per year. Percentage of organizational positions whose job descriptions require specific digital skills. Percentage of employees holding valid technical and digital certificates. Employees' digital skills assessment scores in internal standardized tests.
Human	Digital organizational culture	Score of innovation culture and calculated risk-taking in internal organizational surveys. Number of initiatives and process improvement ideas proposed by employees in the relevant systems. Level of acceptance and use of newly implemented technologies in the organization.
Human	Readiness and acceptance of digital change	Results of the "readiness for digital change" survey among employees and managers. Rate of active or passive resistance to digital transformation projects. Percentage of successfully completed change projects that include digital components.

		Speed of employees' adaptation to new digital systems and processes.
Human	Digital workforce motivation	Existence of a reward and recognition system based on innovation and digital skills. Level of job satisfaction among information technology and data specialists in surveys. Number of career growth opportunities and defined advancement paths for digital specialists.
Human	Distributed digital leadership	Percentage of middle and operational managers who have participated in developing the digital strategy. Degree of delegation of authority to teams for testing and implementing digital solutions. Quality and quantity of senior managers' communication with the organizational body regarding digital transformation.
Technical	Integrated and scalable infrastructure	Percentage of uptime of critical urban systems. Utilized capacity of the data center and bandwidth of the organization's main network. Average response time of citizen service systems. Percentage of high-speed network access coverage in all buildings and areas under management.
Technical	Open digital architecture	Number of public and secure APIs released for developers outside the organization. Percentage of new systems developed according to service-oriented architecture. Existence and active status of a developer portal for the ecosystem. Number of external contributors to the development of urban platform-based solutions.
Technical	Technology architecture and standards	Existence of an approved "Urban Information Technology Architecture" document and the level of project compliance with it. Percentage of software procurements and developments that follow open standards. Number of internal standards developed for data exchange, security, and service quality. Update and review cycle of architecture and standards.
Technical	Cybersecurity	Mean time to detect and respond to security incidents. Number and severity of security incidents occurring annually. Percentage of cybersecurity training courses completed by non-technical personnel. Existence and frequency of testing the "digital business continuity plan." Results of periodic penetration tests.
Strategic	Vision and macro-strategy of digital transformation	Existence of an official, approved, and communicated "digital transformation strategy" document with a specified time horizon. Degree of reflection of digital objectives in the annual operational plans of deputies and districts. Frequency of strategy review and updating based on environmental changes.
Strategic	Digital strategic alignment with the urban mission	Number and significance of digital projects that directly contribute to macro urban development goals, such as traffic reduction and energy consumption optimization. Percentage of the digital transformation budget allocated to the municipality's strategic priorities. Existence of monitoring mechanisms to ensure alignment of technology projects with the urban mission. Degree of integration of information systems with macro urban plans, such as the comprehensive city plan.
Strategic	Innovative digital foresight	Existence of a formal "foresight and technology monitoring" unit or process in the organization. Number of pilot projects implemented for emerging technologies, such as artificial intelligence and blockchain. Number of strategic collaborations with research and development centers and knowledge-based companies. Amount of budget allocated to internal research and development in digital domains.
Process	Optimization and automation of key processes	Number of urban service processes delivered fully and paperlessly. Average completion time of five key service processes before and after digitalization. Percentage reduction in human error in automated processes.
Process	User-centered and multichannel service design	Citizen satisfaction score with digital services. Percentage of urban service requests registered through digital channels, such as web and applications. Number of active service delivery channels, including website, mobile application, kiosk, chatbot, and others. Degree of consistency of information and user experience across all service delivery channels.
Process	Integrated urban management	Number of operational systems in different sectors, such as transportation, lighting, irrigation, and others, connected to a central dashboard. Percentage of urban events and incidents automatically communicated among the relevant systems. Reduction in average response time to urban incidents using the integrated system. Existence of a digital city model for simulation and management.
Process	Analytics orientation and data-driven decision-making in operations	Percentage of operational management decisions made based on analytical reports and dashboards. Number of active predictive models in different urban domains. Frequency and update time of management dashboards based on real-time data. Percentage of operational managers who have direct access to and the ability to work with data analytics tools.
Environmental	Development of integrated urban digital infrastructure	Percentage of public Internet of Things network coverage across the city for managerial purposes. Number and density of sensors installed for monitoring the environment, traffic, and other domains. Degree of integration of data received from urban digital infrastructures with the organization's central system. Percentage of urban construction projects in which a digital infrastructure component has been included.
Environmental	Adaptation to emerging technologies and global trends	Number of formal assessments conducted regarding the adaptability of emerging technologies to the city's needs. Membership and active participation in international smart city networks and associations.

		Adaptation of the organization's technology architecture to dominant global trends, such as edge computing and urban metaverse. Existence of a long-term plan for replacing or upgrading technologies that are becoming obsolete.
Environmental	Environmental and social sustainability of the city	Percentage reduction in resource consumption, including water, electricity, and fuel, resulting from smart digital solutions. Improvement in quality-of-life indicators, including access and citizens' saved time, through digital services. Reduction of inequality in access to urban services among different districts with the help of technology. Degree of reduction in environmental pollutants through digital optimizations, such as smart traffic management.
Environmental	Responsiveness to legal requirements and macro-policymaking	Percentage of legal requirements related to privacy, data, and e-government implemented in the organization. Time required for the organization to comply with new laws and regulations in the digital domain. Level of organizational participation in developing national laws and standards in the smart city domain. Number of supervisory reports submitted to higher-level bodies regarding digital transformation initiatives.
Governance	Strategic digital governance	Existence of an approved digital strategy document. Existence of a "digital transformation steering working group or committee" with an appropriate composition of senior managers. Frequency of regular meetings of the steering working group and percentage of its implemented decisions. Clarity and transparency in distributing digital transformation roles and responsibilities in the organizational chart. Level of authority and budget assigned to the digital governance structure.
Governance	Transformation governance responsibilities	Existence of an approved "digital transformation charter" that specifies boundaries and authorities. Percentage of information technology projects reviewed for compliance with strategy and standards before implementation. Existence of standard processes for approving, monitoring, and evaluating digital projects. Clarity in defining accountability responsibilities for digital project outcomes.
Governance	Integrated data governance and management framework	Existence of a "macro data policy" document approved by the Supreme Council or the organization's senior executive. Percentage of critical datasets governed under a standard classification and protection framework. Existence of mechanisms for dispute resolution and decision-making regarding ownership of and access to shared data. Regular activity of a "data council" or similar body for monitoring the implementation of data governance.
Governance	Digital ethics	Existence of a "charter of ethics for the use of technology and data" in the organization. Percentage of employees who have completed digital ethics awareness courses. Existence of transparent mechanisms for informing citizens about how their data are used. Number of complaints received regarding misuse or discriminatory nature of algorithms and the manner in which they are addressed.
Governance	Digital transparency and oversight	Percentage of financial information, contracts, and macro organizational decisions published online. Number and quality of digital performance reports published for the public. Existence of a platform or system for tracking citizens' requests and complaints. Traceability of important financial and administrative transactions in digital systems.
Ecosystem	Digital participation ecosystem	Number of active memoranda of understanding and partnerships with technology companies, startups, and universities. Percentage of digital projects implemented through public-private partnership or outsourcing models. Existence and number of regular events, such as hackathons and innovation challenges, to attract solutions from the ecosystem. Volume of investment attracted from the private sector for urban digital projects.
Ecosystem	Digital citizenship ecosystem	Rate of citizen participation in urban online surveys, voting, and consultations. Number of ideas and suggestions received from citizens through participatory platforms. Percentage of citizens who regularly use at least one urban digital service. Results of surveys assessing citizens' digital literacy and access to the required tools.
Ecosystem	Development of urban innovation and startup markets	Number of active startups in the field of urban technologies supported by the organization. Existence and activity of acceleration centers and innovation hubs affiliated with the municipality. Volume of contracts concluded with startups and knowledge-based small and medium-sized enterprises. Number of public problem-solving calls issued annually.
Ecosystem	Development of shared digital infrastructures	Number and diversity of basic digital services, such as unified payment and shared authentication, provided to other institutions. Percentage of other urban institutions, such as public transportation and emergency services, connected to the central data platform. Existence of data- and service-sharing agreements with other governmental and public organizations. Reduction in digital development costs for ecosystem member institutions due to the use of shared infrastructure.

Phase Five: Defining and Naming Themes

This phase begins when the researcher has obtained an overall and satisfactory picture of the themes. In this phase, the researcher defines and re-reviews the proposed overarching themes for the analysis and then analyzes the existing data within them. Through this definition and review, the nature and content of each theme are clarified, and it is determined which aspect of the data each overarching theme covers. In this phase, after several rounds of back-and-forth movement and review, 7 overarching themes, 29 organizing themes, and 113 basic themes were ultimately identified.

Phase Six: Producing the Report

This phase begins when the researcher has a set of overarching themes that are fully abstract and consistent with the contextual structures of the research. This phase includes the final analysis and writing of the report, which is presented below. Figure 1 shows the themes obtained.

Figure 1

Thematic Network of the Smart Maturity Model for the Digital Transformation Capability of Urban Management Organizations



Human

The human dimension is recognized as the main cornerstone of digital transformation in urban management organizations, because technology is not transformative in itself; rather, the people who use it are the creators of change. The results of this study show that maturity in this dimension requires coordinated and integrated development across five key components:

Digital Competencies

Digital competencies are the most fundamental component. To move toward smartness, municipalities need a workforce that is not only familiar with digital tools but also capable of data analysis, critical thinking in the digital environment, and continuous learning. Investment in targeted and systematic training based on the real needs of jobs is the first unavoidable step.

Digital Organizational Culture

In the next step, digital organizational culture provides the context for applying these competencies. A culture that encourages innovation, acceptance of failure as part of the learning process, cross-silo collaboration, and customer orientation is the lifeblood of digital transformation. Without such a culture, even with skilled personnel, the organization will fall into the trap of inaction or incomplete implementation of technology.

Readiness and Acceptance of Digital Change

However, having the right skills and culture does not necessarily mean unconditional acceptance of change. The component of readiness and acceptance of digital change emphasizes active management of this painful transition. Resistance to change is natural, and success depends on identifying the reasons for this resistance, such as fear of unemployment, feelings of incompetence, or ambiguity about benefits, and addressing them through transparent communication, stakeholder engagement, and demonstration of tangible benefits.

Digital Workforce Motivation

To facilitate this acceptance, the component of digital workforce motivation plays a vital role. Reward and promotion systems should be designed in such a way that they recognize not only traditional performance but also learning new skills, participation in innovation, and cross-functional collaboration. This strengthens the sense of fairness and stimulates employees' intrinsic motivation to participate actively in transformation.

Distributed Digital Leadership

At the top of this pyramid is distributed digital leadership. Digital transformation is not a technical project within the information technology department; rather, it is a strategic change that requires leadership and unconditional support from senior managers. This leadership should not be centralized but should be distributed across all organizational levels. Middle managers and supervisors, as "change champions" and "digital leaders," should be empowered and given the authority necessary to test and implement solutions within their areas of responsibility. This leadership network ensures that the transformation message flows properly through the organizational body and that implementation barriers are quickly removed.

Technical

The technical dimension functions as the backbone and physical foundation of digital transformation in urban management organizations. This dimension ensures that digital ideas and strategies are built on a strong, reliable, and future-

oriented foundation. Technical maturity does not merely mean purchasing advanced hardware and software; rather, it depends on creating an integrated, flexible, and secure technology ecosystem that supports everything from the simplest services to the most complex urban operations.

Integrated and Scalable Infrastructure

Integrated and scalable infrastructure constitutes the main foundation of this ecosystem. A smart city requires a high-bandwidth network, data centers with maximum availability, and cloud platforms capable of managing the massive volume of data generated by sensors, cameras, and citizen interactions. The scalability of these infrastructures is critical because demand for digital services grows exponentially. Without strong and integrated infrastructure, the organization will face deep challenges such as slow services, frequent outages, and inability to integrate new systems, which severely undermine public trust and operational efficiency.

Open Digital Architecture

To prevent the creation of new information silos and ensure collaboration among systems, the components of open digital architecture and technology architecture and standards play a key role. Open architecture, relying on standard APIs and interoperable platforms, enables the connection of internal systems and collaboration with external providers and developers. This approach extends innovation from within the organization to the entire urban ecosystem.

Technology Architecture and Standards

The development and rigorous implementation of unified technology architecture and standards prevent resource waste in developing parallel and incompatible solutions and facilitate system maintenance, upgrading, and security. These standards should cover the technology lifecycle from selection to retirement.

Cybersecurity

As urban life becomes increasingly dependent on digital systems, cybersecurity is elevated from a technical consideration to a governance and social necessity. Cyberattacks can not only disrupt urban services but also endanger citizens' safety, for example through manipulation of traffic or hospital systems, as well as their privacy. Therefore, security should not be regarded as a cost but as a fundamental investment in the city's digital resilience. A mature security framework includes layered protection across endpoints, networks, cloud, and applications; continuous vulnerability management; security awareness training for all employees; and strong incident response and business continuity plans.

Strategic

The strategic dimension acts as the brain and compass in the digital transformation process of urban management organizations. This dimension responds to the "why" and "how" of the organization's movement toward a digital future and ensures that large-scale technological investments are not merely a pursuit of fashion but serve the fulfillment of the core mission and the creation of tangible value for the city and citizens. Strategic maturity moves the organization from a "reactive and project-oriented" state to a "proactive and transformative" state.

Vision and Macro-Strategy of Digital Transformation

An inspiring and clear vision provides a shared and tangible image of the "desired digital city" within a specified time horizon and gives direction to all actions. This vision should be manifested in an official, approved, and communicated strategic document that specifies not only macro objectives but also priorities, governing principles, and the general implementation framework. The existence of such a document reduces fragmented decision-making and provides a criterion

for evaluating all technological plans and projects. Without it, the organization becomes submerged in a sea of technological opportunities and will be unable to concentrate resources on the areas with the greatest impact.

Digital Strategic Alignment with the Urban Mission

Developing a strategy is not sufficient; the vital component is digital strategic alignment with the urban mission, which serves as the bridge between technology and public value. Digital transformation should not be the ultimate goal; rather, it is an enabling tool for achieving macro urban goals such as improving quality of life, environmental sustainability, crisis resilience, equitable economic development, and transparent governance. Maturity in this component requires every digital project to clearly explain how it contributes to achieving these macro goals. This alignment should be objectively reflected in budget allocation, macro performance indicators, and monitoring mechanisms. Digital transformation is successful when traffic reduction, energy savings, increased citizen satisfaction, or financial transparency can be directly attributed to digital interventions.

Innovative Digital Foresight

In a world characterized by the increasing acceleration of technological change, strategic maturity depends on developing the capability of innovative digital foresight. This component transforms the organization from a passive consumer of technology into an active and anticipatory actor in the innovation arena. Foresight means continuous monitoring of technological trends, such as generative artificial intelligence, quantum computing, and the metaverse; analyzing their impacts on the city and citizenship; and testing these technologies on a small and controlled pilot scale. Establishing research and development units, participating in urban living labs, and engaging in strategic collaboration with universities and startups are mechanisms for institutionalizing this future-oriented perspective. This approach enables the organization not only to keep pace with changes but also to become a pioneer and rule-maker in some areas.

Process

The leadership dimension is considered the most vital and influential pillar in establishing effective communication with Generation Z. This generation does not seek leaders who issue orders from a position of power; rather, it seeks inspiring guides who can create a nurturing environment and help their personal and professional growth. Success in guiding Generation Z requires moving beyond traditional “management and control” models and moving toward “leadership and empowerment.”

Optimization and Automation of Key Processes

Optimization and automation of key processes are the starting point of this operational transformation. The goal is to eliminate waste, reduce task completion time, and remove errors caused by human intervention in repetitive but critical processes, such as issuing permits, handling complaints, and financial payments. However, maturity in this component goes beyond paper digitalization; it requires radical redesign of processes before automation. An inefficient process that is automated only fails faster. Therefore, the focus should be on simplification, standardization, and elimination of unnecessary steps so that automation can generate maximum productivity.

User-Centered and Multichannel Service Design

Optimized internal processes reach full maturity when they are delivered to society in the form of user-centered and multichannel service design. This component changes the *raison d'être* of the urban management organization from “administering” to “serving.” A user-centered approach means deeply understanding citizens’ pain points, expectations, and

behaviors and designing services based on these insights. Services should be simple, intuitive, and accessible through diverse channels, including web, mobile application, kiosk, and telephone. Maturity here is not defined by the number of channels but by the integration of user experience across all of them and the quality of interaction. Regardless of the channel, the citizen should feel that they are interacting with a single, smart, and responsive municipality.

Integrated Urban Management

The inherent complexity of the city as a living system requires the component of integrated urban management. This component emphasizes breaking down information and operational walls among different sectors, such as transportation, water, electricity, green space, and crisis management. Maturity in this domain is achieved through integrated operational dashboards, real-time data exchange platforms, and even a digital city model. This integration enables understanding the city as a whole, predicting the impact of decisions in one sector on another, and coordinating effective responses to complex events such as floods, widespread power outages, or major events. Ultimately, this maturity leads to a smarter and more resilient city.

Analytics Orientation and Data-Driven Decision-Making in Operations

The main driver of these process transformations is analytics orientation and data-driven decision-making in operations. Maturity in this component means moving beyond simple historical reporting toward predictive and prescriptive analytics. This requires a data culture in which operational managers have access to high-quality and up-to-date data and are able to interpret them. The use of simulation models and artificial intelligence to predict traffic, optimize waste collection routes, or forecast the need for infrastructure maintenance are excellent examples of this maturity. Decision-making shifts from an “experience-based and intuitive” mode to a “data-driven and evidence-based” mode, which significantly increases efficiency and effectiveness.

Environmental

The environmental dimension in the digital transformation maturity model views the urban management organization not as an isolated entity but as part of a complex urban, national, and global ecosystem. This dimension focuses on the organization’s intelligent, responsible, and future-oriented interaction with the broader context in which it operates. Environmental maturity means moving from a passive and reactive approach toward the surrounding environment to an active, proactive, and constructive approach in which digital technology becomes a tool for strengthening the organization’s links with the city, law, nature, and the future.

Development of Integrated Urban Digital Infrastructure

The component of developing integrated urban digital infrastructure highlights the organization’s role as the architect and developer of the city’s physical-digital foundation. This goes beyond the organization’s internal needs and requires a holistic view that treats digital infrastructures, such as sensor networks, cameras, Wi-Fi access points, and local data centers, as new public facilities. Maturity in this area means planning and implementing these infrastructures in a way that supports not only the municipality’s operational needs but also the innovation potential of the private sector, improvement of citizens’ quality of life, and integrated management of the city’s physical space. Such infrastructure is the digital backbone of the smart city.

Adaptation to Emerging Technologies and Global Trends

In a world characterized by the increasing acceleration of technological innovation, the component of adaptation to emerging technologies and global trends is a strategic necessity. This does not mean blindly following technological fashions;

rather, it means creating organizational capacity to monitor, evaluate, test, and selectively absorb technologies that are most compatible with the city's specific context, challenges, and opportunities. Membership in international smart city networks, participation in pilot projects, and development of foresight units are mechanisms for institutionalizing this intelligent adaptability. The goal is to reduce the digital gap with global leaders and avoid being locked into obsolete technologies.

Environmental and Social Sustainability of the City

The component of environmental and social sustainability of the city is the ultimate test of responsibility and value creation in digital transformation. Digital technologies must explicitly serve the goals of sustainable urban development. Maturity in this area requires defining and monitoring quantitative indicators that show the direct impact of digital solutions on reducing resource consumption, including energy and water; reducing pollution, including greenhouse gases and traffic; promoting social justice, including equitable access to services; and improving citizens' quality of life. Digital transformation is sustainable when it helps solve the city's fundamental problems, rather than merely adding a layer of technical complexity to them or creating a new digital divide.

Responsiveness to Legal Requirements and Macro-Policymaking

The component of responsiveness to legal requirements and macro-policymaking provides the necessary framework for the legitimacy, security, and social acceptance of digital transformation. This includes active compliance with laws related to privacy, personal data, e-government, and cybersecurity. However, real maturity goes beyond passive compliance and includes constructive participation in the process of developing national standards, regulations, and policies related to smart cities. An urban management organization that matures in this area not only takes advantage of opportunities but also helps shape governance frameworks and reduces future legal and reputational risks.

Governance

The governance dimension in the digital transformation maturity model plays the role of the central nervous system and supervisory framework for the entire transformation process. This dimension focuses on creating structures, processes, regulations, and principles that ensure digital transformation is guided and controlled in a transparent, responsible, efficient manner and in accordance with social values. Maturity in governance moves the organization from a state of "trial and error" and "scattered initiatives" toward systematic, risk-oriented, and principle-based management.

Strategic Digital Governance

Strategic digital governance is the main pillar of this framework. This component emphasizes the creation of formal institutions and high-level decision-making processes, such as a digital transformation steering working group or committee, which ensure that digital transformation is aligned and integrated with the macro-strategy of the organization and the city. Maturity in this area requires clear definition of roles and responsibilities, allocation of sufficient authority and resources to these institutions, and creation of mechanisms for continuous monitoring of progress and adaptation of the strategy to environmental changes. Without this level of governance, digital transformation will lack a clear direction and priority.

Transformation Governance Responsibilities

Transformation governance responsibilities operationalize this strategy. This component focuses on defining standard processes for approval, budgeting, implementation, monitoring, and evaluation of digital projects and investments. The goal is to create financial and operational discipline, ensure return on investment, and prevent repetitive or incompatible investments. Maturity here means full transparency regarding why projects are selected, how resources are allocated, and

how managers are held accountable for results. A strong transformation governance process guides projects from “idea” to “value creation.”

Integrated Data Governance and Management Framework

As data become the most important digital asset, an integrated data governance and management framework becomes a vital necessity. This component goes beyond technical data management and addresses policies, standards, and responsibilities that ensure data quality, security, privacy, availability, and usability across the organization. Maturity in this area requires clear determination of “data owners,” development of internal and external sharing policies, and creation of mechanisms for resolving data-related disputes. Effective data governance provides the foundation for trust and enables data-driven decision-making.

Digital Ethics

In the age of algorithms and digital surveillance, the component of digital ethics safeguards the social and human legitimacy of transformation. This component addresses fundamental questions about fairness, inclusion, accountability, and the social impact of technology. Maturity in digital ethics means developing a clear ethical charter for technology development and use, assessing the social impacts of algorithms to prevent discrimination, and creating complaint and redress mechanisms for citizens. This prevents technology from becoming a tool of surveillance or discrimination and builds public trust.

Digital Transparency and Oversight

Complementing this ethics is the component of digital transparency and oversight, which makes the principle of accountability tangible. Maturity in this area means proactively publishing information, including open data, performance reports, and contracts, through digital channels and enabling public tracking and oversight of processes and decisions. This not only reduces misuse but also encourages citizens to participate knowingly and trust the system. Transparency is the cornerstone of good governance and active citizenship in the digital age.

Ecosystem

The ecosystem dimension in the digital transformation maturity model represents the transition of the urban management organization from a centralized and self-sufficient institution to a vital and facilitating node in a complex and dynamic value-creation network. This dimension is based on the principle that complex urban challenges in the digital age exceed the capacity and resources of a single organization, and solving them requires collaboration, co-creation, and the use of the collective intelligence of the entire urban ecosystem. Ecosystem maturity upgrades the organization from an “exclusive service provider” to a “platform builder and coordinator of collective innovation.”

Digital Participation Ecosystem

The digital participation ecosystem provides a framework for structured collaboration with powerful external actors. This component focuses on creating and strengthening strategic partnerships with the private sector, including large and small technology companies, universities, and research centers. Maturity in this area means moving from a buyer-seller relationship toward risk-sharing partnerships, joint investment, and co-creation of solutions. The goal is to access private-sector expertise, technology, and capital, as well as to direct academic research toward the city’s practical problems. These partnerships exponentially increase the organization’s innovation and implementation capacity.

Digital Citizenship Ecosystem

At a more micro and inclusive level, the digital citizenship ecosystem emphasizes empowering and directly engaging citizens as partners and monitors of transformation. This component goes beyond one-way information dissemination and is based on creating platforms for consultation, collective thinking, social monitoring, and even co-creation of services. Maturity here means designing attractive and inclusive mechanisms for participation, incorporating the results of participation into decision-making, and being accountable for them. A mature citizenship ecosystem not only increases the legitimacy and public acceptance of initiatives but also uses collective intelligence and creativity to identify problems and provide innovative solutions.

Development of Urban Innovation and Startup Markets

To cultivate and accelerate innovation, the component of developing urban innovation and startup markets is essential. An urban management organization that matures in this area plays the role of an early customer, accelerator, and intelligent regulator for urban technology startups. This can be achieved through establishing specialized innovation and acceleration centers, issuing problem-solving calls or innovation challenges, and facilitating regulations for testing new solutions. The goal is to turn the city into a “living laboratory” in which startups can test and improve their products, while the organization gains access to a wide range of agile and cost-effective solutions.

Development of Shared Digital Infrastructures

The technical foundation of effective collaboration in this broad ecosystem is the component of developing shared digital infrastructures. This component emphasizes the creation of platforms, standards, and basic digital services that can be used by the entire ecosystem, including other governmental organizations, the private sector, and citizens. Examples include an integrated urban data platform with open APIs, a shared authentication service, or a unified payment infrastructure. Maturity in this area reduces the cost of entry and collaboration for all actors, prevents fragmentation, and concentrates innovation on a strong and shared foundation.

Discussion and Conclusion

The findings of the present study resulted in the development of a smart maturity model for the digital transformation capability of urban management organizations consisting of seven overarching dimensions, including human, technical, strategic, process, environmental, governance, and ecosystem dimensions, alongside 29 organizing themes and 113 basic themes. The emergence of these dimensions confirms that digital transformation in urban management cannot be understood as a purely technological phenomenon but rather as a multidimensional organizational transformation that requires simultaneous development across human, organizational, technological, governance, and environmental domains. This finding aligns with the growing body of literature that conceptualizes digital transformation as a comprehensive organizational change process rather than a simple technological upgrade [1, 9, 15]. The comprehensiveness of the identified model further supports arguments suggesting that successful smart city initiatives depend on the interaction of multiple organizational capabilities and governance mechanisms rather than isolated investments in digital infrastructure [2, 3, 8].

The human dimension emerged as one of the most critical pillars of digital transformation maturity. The identified themes, including digital competencies, digital organizational culture, readiness and acceptance of digital change, digital workforce motivation, and distributed digital leadership, indicate that people remain the primary drivers of transformation. This finding reinforces previous studies emphasizing that digital transformation succeeds only when employees possess the necessary

competencies, demonstrate willingness to embrace change, and operate within supportive organizational cultures [26, 28, 29]. The importance of digital competencies identified in this study is particularly consistent with the work of Slavković et al., who demonstrated that digital capabilities significantly influence organizational transformation outcomes through enhanced digital citizenship and organizational adaptability [29]. Similarly, the emphasis on distributed digital leadership supports research highlighting the necessity of leadership engagement across all organizational levels rather than relying exclusively on top-management initiatives [8, 9].

The results also revealed that digital organizational culture and employee motivation are indispensable components of maturity. Municipal employees often face uncertainty, role changes, and technological disruptions during transformation initiatives. Consequently, organizational cultures that encourage innovation, experimentation, collaboration, and learning are more likely to facilitate transformation success. This observation corresponds with findings from studies emphasizing the role of organizational culture as a fundamental enabler of digital innovation and long-term transformation sustainability [16, 27, 28]. The identified importance of readiness for change additionally supports organizational change management perspectives suggesting that resistance management, communication strategies, and stakeholder involvement significantly influence digital transformation outcomes [9, 10].

The technical dimension identified in this study includes integrated and scalable infrastructure, open digital architecture, technology architecture and standards, and cybersecurity. These findings underscore the continuing importance of technological foundations in enabling digital transformation. Urban management organizations increasingly rely on interconnected systems, large-scale data processing capabilities, and digital service platforms that require reliable technological infrastructures. The identified importance of integrated and scalable infrastructure is strongly supported by research demonstrating that digital infrastructure constitutes a fundamental prerequisite for successful transformation initiatives [17, 20, 30]. Similarly, the emergence of open digital architecture and interoperability reflects contemporary smart city approaches that emphasize platform ecosystems and cross-organizational collaboration [1, 2].

Cybersecurity emerged as another essential technical maturity component. This finding reflects the increasing dependence of urban systems on digital technologies and the corresponding growth of cyber risks. As municipalities manage sensitive citizen information and critical infrastructure systems, cybersecurity becomes a strategic concern rather than merely a technical issue. This result aligns with contemporary urban governance literature emphasizing the need for secure digital ecosystems capable of protecting public trust while ensuring uninterrupted service delivery [6, 7]. The integration of cybersecurity within the maturity framework further highlights the shift toward resilience-oriented digital governance models.

The strategic dimension identified through thematic analysis highlights the importance of digital vision, strategic alignment, and innovative foresight. These findings suggest that mature digital transformation requires a clear strategic direction that aligns technological investments with broader urban development objectives. The identified emphasis on digital strategic alignment supports previous studies indicating that technology adoption without strategic coherence often produces fragmented and unsustainable outcomes [9, 15]. Urban management organizations that successfully align digital initiatives with urban sustainability, service quality, citizen satisfaction, and economic development goals are more likely to achieve meaningful transformation outcomes [3, 4].

The identification of innovative digital foresight as a strategic maturity component is particularly noteworthy. This finding indicates that digital transformation maturity is not solely concerned with current capabilities but also involves the capacity to anticipate future technological developments and emerging urban challenges. Such foresight capabilities enable municipalities to proactively adapt to technological innovations and changing stakeholder expectations. This observation is consistent with studies emphasizing future-oriented governance, innovation monitoring, and technological experimentation as critical elements of digital transformation success [5-7].

The process dimension includes optimization and automation of key processes, user-centered and multichannel service design, integrated urban management, and analytics-oriented decision-making. These findings suggest that organizational maturity is reflected not only in technological adoption but also in the redesign and improvement of operational processes. The importance of process optimization confirms that digital transformation requires fundamental changes in how organizations create, deliver, and manage services. This finding aligns with previous maturity models emphasizing process redesign as a critical mechanism for realizing digital transformation benefits [18, 21, 22].

Furthermore, the prominence of data-driven decision-making reflects the growing significance of analytics and evidence-based governance in smart cities. Municipal organizations increasingly generate and collect vast amounts of urban data, creating opportunities for predictive analytics, performance monitoring, and intelligent decision-making. The identification of analytics orientation as a maturity dimension supports studies demonstrating that data utilization capabilities significantly enhance organizational performance and service effectiveness [1, 12, 20]. Likewise, the emphasis on user-centered service design aligns with smart city principles that prioritize citizen experience and service accessibility as central transformation objectives [5, 11].

The environmental dimension represents one of the distinctive contributions of the proposed maturity model. The identified themes include integrated urban digital infrastructure development, adaptation to emerging technologies, environmental and social sustainability, and responsiveness to legal and policy requirements. These findings indicate that urban digital transformation must be evaluated within broader environmental, regulatory, and societal contexts. This perspective extends beyond conventional maturity models by explicitly incorporating sustainability and environmental responsibility into digital transformation assessment [3, 4, 27].

The integration of sustainability considerations is particularly important given increasing concerns regarding climate change, resource efficiency, and urban resilience. Digital technologies possess substantial potential to contribute to sustainable urban development through optimized resource utilization, intelligent infrastructure management, and improved environmental monitoring. The findings therefore support contemporary views that digital transformation and sustainable development should be pursued as mutually reinforcing objectives rather than independent initiatives [3, 4]. Similarly, the identified importance of legal and policy responsiveness aligns with growing recognition that digital transformation occurs within complex regulatory environments requiring adaptive governance capacities [7, 14].

The governance dimension emerged as another fundamental pillar of maturity. The identified themes include strategic digital governance, transformation governance responsibilities, integrated data governance and management, digital ethics, and digital transparency and oversight. These findings demonstrate that digital transformation maturity requires formal governance mechanisms capable of coordinating complex organizational changes while ensuring accountability,

transparency, and ethical technology use. This result strongly aligns with recent studies emphasizing governance capacity as one of the most important determinants of municipal digital transformation success [6-8].

The identification of data governance and digital ethics as separate maturity components reflects the evolving challenges associated with extensive data collection and algorithmic decision-making in smart cities. As municipalities increasingly rely on data-driven governance, concerns regarding privacy, fairness, transparency, and accountability become increasingly significant. These findings support contemporary governance literature advocating stronger institutional mechanisms for managing digital risks and maintaining public trust [7, 14]. Moreover, the emphasis on transparency and oversight highlights the importance of open government principles within digital transformation initiatives.

Finally, the ecosystem dimension reveals the importance of collaborative networks and external stakeholder engagement in digital transformation maturity. The identified themes include digital participation ecosystems, digital citizenship ecosystems, innovation and startup market development, and shared digital infrastructures. These findings demonstrate that municipalities can no longer operate as isolated entities in pursuing digital transformation. Instead, successful transformation increasingly depends on partnerships with citizens, universities, technology companies, startups, and other governmental institutions. This observation strongly aligns with ecosystem-oriented smart city theories emphasizing collaborative innovation and network governance [1, 2, 12].

The importance of citizen participation identified in this study is particularly consistent with recent research suggesting that digital citizenship contributes significantly to digital transformation success by fostering engagement, trust, and collective problem-solving [29]. Similarly, the emphasis on innovation ecosystems supports studies highlighting the role of startups, entrepreneurial actors, and knowledge institutions in accelerating urban digital innovation and technological diffusion [2, 5]. The ecosystem dimension therefore extends existing maturity frameworks by explicitly recognizing the interdependent nature of contemporary digital transformation processes.

Overall, the findings suggest that digital transformation maturity in urban management organizations emerges through the interaction of human, technical, strategic, process, environmental, governance, and ecosystem capabilities. The proposed model advances existing knowledge by integrating these dimensions into a comprehensive framework specifically tailored to urban management organizations. Unlike many existing models that emphasize limited technological or organizational aspects, the present model provides a holistic perspective that captures the complexity of municipal digital transformation. Consequently, the findings contribute both theoretically and practically to the growing literature on digital transformation capability and smart city governance [21, 22, 24].

One limitation of this study is that the findings were derived from qualitative interviews with a specific group of academic experts, municipal managers, and senior specialists. Although the participants possessed substantial experience and expertise, the identified themes may reflect context-specific perspectives that could vary across different municipalities, regions, and governance systems. In addition, the study focused on developing a conceptual maturity model and did not empirically validate the proposed framework through large-scale quantitative testing. Therefore, caution should be exercised when generalizing the findings to all urban management organizations.

Future studies may validate the proposed maturity model using quantitative approaches such as structural equation modeling, confirmatory factor analysis, or multicriteria decision-making techniques. Researchers may also compare digital transformation maturity levels across municipalities of different sizes, governance structures, and developmental contexts.

Longitudinal studies examining how maturity evolves over time would provide valuable insights into transformation trajectories and organizational learning processes. Furthermore, future research may investigate the relationships between maturity dimensions and specific outcomes such as service quality, citizen satisfaction, organizational performance, urban sustainability, and innovation capacity.

Urban management organizations should adopt a holistic approach to digital transformation that simultaneously addresses human, technical, strategic, process, governance, environmental, and ecosystem dimensions. Municipal leaders should invest in digital skills development, foster innovation-oriented cultures, establish robust governance mechanisms, and strengthen data management capabilities. Strategic planning should ensure alignment between digital initiatives and broader urban development goals. Municipalities should also cultivate collaborative ecosystems involving citizens, universities, startups, and private-sector partners while continuously monitoring emerging technologies and sustainability requirements. The proposed maturity model can serve as a practical diagnostic and planning tool to guide municipalities in assessing current capabilities, prioritizing improvement initiatives, and designing systematic roadmaps for digital transformation advancement.

Acknowledgments

We would like to express our appreciation and gratitude to all those who cooperated in carrying out this study.

Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Written consent was obtained from all participants in the study.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

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