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ORIGINAL ARTICLE

Presenting a Digital Government Architecture Model in the Development of Smart Services, Case Study: Tehran Municipality

Farhad Najafi Esfahani[1], Mohammad Mohammadi[2*], Mandan Momeni[3]

1. Department of Public Administration and Public Policy, Ct.C, Islamic Azad University, Tehran, Iran.
2. Department of Public Administration and Public Policy, Ct.C, Islamic Azad University, Tehran, Iran.
3. Department of Public Administration and Human Resources, Ct.C, Islamic Azad University, Tehran, Iran.

***Correspondence**
Mohammad Mohammadi
Mo.mohammadi@iauctb.ac.ir

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EXTENDED ABSTRACT

Introduction

The convergence of digital transformation and urban governance is a critical imperative for contemporary metropolitan management, especially in developing economies aiming to enhance service efficiency and citizen satisfaction. Smart cities signify a paradigm shift from traditional management to data-driven, technology-enabled governance, leveraging digital infrastructure to optimize resource allocation and foster sustainable development. However, transitioning to such ecosystems requires a comprehensive architectural framework that integrates technical infrastructure, governance mechanisms, and value-creation processes.

Digital Government Architecture (DGA) serves as the foundational blueprint for this transition. Despite growing global interest in smart city initiatives, a significant gap persists in understanding how DGA components interact within specific institutional and cultural contexts—particularly in Middle Eastern megacities like Tehran, where traditional governance structures coexist with rapid technological adoption.

Existing literature frequently prioritizes technological dimensions (IoT, big data, cloud computing) while overlooking the governance and value-creation aspects essential for implementation. Furthermore, most conceptual models are derived from Western contexts, often failing to account for the unique regulatory and social landscapes of developing nations. This research addresses these gaps by developing a context-sensitive, Structural-Interpretive Model that explicates the hierarchical relationships and causal pathways of DGA components within the Tehran Municipality. This study moves beyond technology-centric approaches to offer a holistic perspective, providing actionable insights for policymakers and administrators through a causally structured hierarchy.

Methodology

This study adopts a pragmatic paradigm, utilizing a sequential mixed-methods design to analyze the complex socio-technical system of DGA.

Phase 1: Qualitative Exploration

The qualitative phase employed semi-structured interviews to elicit expert insights. Following an actor-protocol approach, 20 specialized managers and senior officials from key municipal divisions (e.g., IT, Urban Planning, Strategic Management) were purposively sampled. Theoretical saturation was achieved at the 20th interview. Transcripts were analyzed using Clarke's (2006) reflexive thematic analysis in MAXQDA 2020. Inter-coder reliability was confirmed with a Cohen's kappa of 0.82. The analysis identified 9 overarching themes, 27 organizing themes, and 68 basic themes, categorized into three meta-dimensions: Technical Infrastructure, Governance, and Value Creation.

Phase 2: Structural Modeling

To transform qualitative findings into a causal hierarchy, Interpretive Structural Modeling (ISM) was employed. Fifteen senior municipal experts evaluated the pairwise directional influence of the 9 overarching themes using a four-point scale. The ISM procedure involved constructing a Structural Self-Interaction Matrix (SSIM), deriving a Final Reachability Matrix via Boolean logic, and partitioning elements into hierarchical levels based on driving power and dependence. The

model was finalized using MATLAB and validated for content and construct coherence through expert review and theoretical alignment.

Findings

The integrated analysis yielded a four-level hierarchical structural model of DGA for smart urban services, revealing distinct causal layers from foundational drivers to ultimate outcomes.

Level 4 (Foundational Drivers): Three themes emerged as the deepest structural elements with high driving power and low dependence, serving as the fundamental prerequisites for DGA implementation:

1. Urban Digital Regulation: This theme encompasses the legal and regulatory frameworks governing data privacy, digital service standards, interoperability requirements, and accountability mechanisms. Findings indicate that absence of clear regulatory guidelines creates implementation paralysis, as municipal departments hesitate to launch digital services without legal certainty regarding data handling, citizen rights, and liability issues.

2. Digital Transformation Governance: This theme captures the organizational structures, leadership commitment, strategic planning processes, and change management capabilities necessary for coordinating digital initiatives across municipal departments. Participants emphasized that fragmented governance—where each department pursues independent digital projects without coordination—leads to duplicated efforts, incompatible systems, and poor citizen experience.

3. Urban Digital Technology Architecture: This theme represents the technical infrastructure foundation, including cloud computing platforms, data centers, network connectivity, cybersecurity systems, and integration middleware. Interviewees highlighted that inadequate technical architecture creates bottlenecks that prevent scaling of digital services and integration of data across municipal functions.

These foundational drivers exhibit strong causal influence on all higher-level components but are themselves relatively independent of other factors, indicating they must be established early in DGA development and require sustained investment and policy attention.

Level 3 (Enabling Mechanisms): Two themes function as critical linkage factors that translate foundational drivers into operational capabilities:

1. Digital Participation and Citizen Interaction: This theme encompasses digital channels for citizen engagement (mobile apps, web portals, social media), participatory decision-making platforms, feedback mechanisms, and co-creation processes. Analysis revealed that effective citizen interaction depends on both technical infrastructure (Level 4) and regulatory clarity regarding data use, while simultaneously enabling improved service delivery (Level 2).

2. Digital Security and Urban Protection: This theme addresses cybersecurity measures, data protection protocols, system resilience, and privacy safeguards. Participants identified security as a dual concern—both a technical requirement dependent on infrastructure quality and a governance issue requiring clear policies—that directly impacts citizen trust and service adoption rates.

These enabling mechanisms exhibit moderate driving power and moderate dependence, serving as bridges between foundational elements and operational outcomes. Their intermediate position indicates they require simultaneous attention to both infrastructure development and service delivery optimization.

Level 2 (Operational Outcomes): Two themes represent the direct service delivery results that citizens experience:

1. Ease and Speed of Service Delivery: This theme captures service accessibility, transaction simplicity, processing time reduction, and multi-channel availability. Quantitative data from municipal records indicated that digital service implementation reduced average transaction times by 60-75% compared to traditional in-person processes, while citizen satisfaction scores increased by 40% for digitally-delivered services.

2. Digital Urban Data Management*: This theme encompasses data collection, storage, analysis, and utilization for decision-making and service personalization. Participants noted that effective data management enables predictive service delivery, proactive problem identification, and evidence-based policy formulation.

These operational outcomes exhibit low driving power but high dependence, indicating they result from effective implementation of lower-level components rather than driving further changes themselves.

Level 1 (Ultimate Goals): Two themes emerged as the highest-level outcomes representing the ultimate objectives of DGA implementation:

1. Sustainability and Continuous Improvement of Urban Services: This theme reflects long-term service quality enhancement, resource efficiency, environmental sustainability, and adaptive capacity. Participants emphasized that digital systems enable continuous monitoring and iterative improvement cycles that were impossible with traditional manual processes.

2. Integrated Smart Urban Services Ecosystem: This theme represents the holistic integration of services across municipal functions, creating seamless citizen experiences and optimized resource

allocation through data sharing and process coordination.

These ultimate goals exhibit very low driving power and very high dependence, confirming their position as end-state outcomes that depend on successful implementation of all lower-level components.

Cross-cutting Findings: Several important patterns emerged across the hierarchical structure. First, governance factors (regulation, organizational structures) proved equally important as technical infrastructure, contradicting technology-centric approaches that prioritize hardware and software over institutional arrangements. Second, citizen engagement emerged as a critical mediating factor rather than a final outcome, suggesting that participatory mechanisms must be built into DGA design rather than added after technical implementation. Third, security and privacy concerns pervade all levels, requiring integrated attention rather than treatment as isolated technical issues.

Discussion and Conclusion

This research advances the discourse on Digital Government Architecture (DGA) by moving beyond technology-deterministic models. It establishes that governance and value-creation dimensions are as critical as technical infrastructure, offering a nuanced hierarchical structure that captures complex causal pathways and feedback loops-an improvement over traditional, linear taxonomies.

The findings demonstrate that *Urban Digital Regulation, Digital Transformation Governance, and Urban Digital Technology Architecture* act as foundational drivers. Their identification explains the failure of many smart city initiatives that prioritize visible applications over underlying frameworks. Furthermore, the role of *Digital Participation* and *Digital Security* as intermediate "linkage factors" indicates that these elements must be developed concurrently with both foundational and operational components. Practically, the study offers a strategic roadmap for Tehran Municipality: prioritizing regulatory and governance reforms is a prerequisite for the successful implementation of citizen-engagement platforms and data-driven management.

The study identifies three key drivers of DGA implementation: (1) Leadership commitment, essential for overcoming organizational inertia; (2) Interoperability standards, which prevent data fragmentation; and (3) Citizen trust, generated through transparency and reliable service delivery, which remains the ultimate determinant of value realization.

While this model offers significant insights, its focus on Tehran limits its immediate generalizability to vastly different institutional environments. Additionally, the cross-sectional design captures a static snapshot of a dynamic transformation process. Future research should prioritize: (1) large-scale quantitative validation of the structural model, (2) comparative studies across diverse metropolitan contexts to isolate universal patterns, and (3) the integration of citizen-centric perspectives to complement the current expert-driven framework.

Successful DGA for smart urban services requires a holistic integration of technical, governance, and value-creation dimensions. For Tehran and similar megacities, this research provides a diagnostic tool to assess architectural maturity and a prescriptive framework to prioritize investments. By establishing foundational drivers-regulation, governance, and infrastructure-before pursuing operational outcomes, municipal administrators can better navigate the transition toward truly smart, citizen-centered urban governance.

K E Y W O R D S

Digital Government Architecture, Smart Urban Services, Thematic Analysis, Interpretive Structural Modeling.