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Presenting a Smart Management Model of Innovative Solutions for Improving Urban Governance: A Case Study of the Tehran Firefighting and Safety Services Organization

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ABSTRACT

Technological transformations and the expansion of smart city approaches have increasingly highlighted the necessity of revising models of urban management and governance. In this regard, the present study was conducted with the aim of designing a smart management model based on innovative solutions to improve urban governance within the Tehran Firefighting and Safety Services Organization. In terms of purpose, the study is applied, and in terms of methodology, it adopts a mixed-methods (qualitative–quantitative) design. In the qualitative phase, drawing on the grounded theory approach, data were collected and analyzed through in-depth interviews with experts in urban management, firefighting, and emerging technologies. The coding process led to the extraction of key categories within a paradigmatic model encompassing causal conditions, contextual conditions, intervening conditions, strategies, and consequences. In the quantitative phase, partial least squares structural equation modeling (PLS-SEM) was employed to validate the extracted model. The statistical population consisted of managers and specialists of the Tehran Firefighting and Safety Services Organization. The results of data analysis indicated that data quality, resource constraints, and institutional barriers are among the most significant challenges facing the implementation of smart management. In contrast, outcomes such as optimization of emergency operations, enhancement of predictive and preventive capabilities, resource savings, improvement of citizen safety, and strengthening of the organization's social standing were identified as the most important expected achievements. Model fit indices also confirmed the validity and appropriate fit of the proposed model. Overall, the findings demonstrate that the smart management model can play an effective role in enhancing efficiency, resilience, and smart urban governance within the Tehran Firefighting Organization.

Keywords: Smart management; urban governance; innovative solutions; Firefighting and Safety Services Organization; smart city; grounded theory; structural equation modeling

Introduction

Rapid urbanization, technological acceleration, and increasing societal complexity have fundamentally transformed the nature of urban governance across the globe. Cities are no longer merely administrative units for service provision; rather, they have become dynamic socio-technical ecosystems in which governance effectiveness depends on the intelligent integration of data, technology, institutions, and human capital. In this

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context, the concept of *smart cities* has emerged as a dominant paradigm for addressing urban challenges such as sustainability, safety, efficiency, resilience, and citizen participation (1-3). However, the success of smart cities is increasingly recognized to depend not only on technological deployment but also on the quality of governance structures that guide decision-making, coordination, and accountability within urban systems (4, 5).

Smart urban governance represents an evolution from traditional hierarchical and bureaucratic governance models toward more adaptive, participatory, data-driven, and network-based approaches. This shift reflects the growing complexity of urban problems, which often transcend organizational boundaries and require real-time coordination among multiple stakeholders (6, 7). Scholars emphasize that smart governance integrates digital technologies, institutional innovation, and collaborative governance mechanisms to enhance policy effectiveness, transparency, and responsiveness (8, 9). Consequently, smart governance has become a critical pillar of sustainable urban development and an essential prerequisite for achieving the broader goals of smart cities (3, 10).

Within the literature, smart governance is commonly conceptualized as the capacity of urban institutions to leverage information and communication technologies (ICTs), data analytics, and intelligent systems to improve public value creation, service delivery, and citizen engagement (4, 8). Recent studies further expand this definition by emphasizing the role of artificial intelligence, the Internet of Things (IoT), and big data platforms in enabling predictive, preventive, and evidence-based governance (11, 12). These technologies facilitate the transition from reactive governance to proactive and anticipatory governance, particularly in high-risk urban domains such as crisis management, environmental protection, and public safety (13, 14).

Despite the global diffusion of smart city initiatives, empirical evidence suggests that many projects fail to achieve their intended governance outcomes due to institutional fragmentation, limited organizational capacity, resistance to change, and inadequate strategic alignment (1, 15). This has led researchers to argue that technological solutions alone are insufficient and must be embedded within coherent smart management frameworks that align policy, organizational culture, leadership, and operational processes (16, 17). Accordingly, the concept of *smart management* has gained increasing attention as an integrative approach that operationalizes smart governance principles within urban organizations (18, 19).

Smart management refers to the systematic application of intelligent technologies, data-driven decision-making, and adaptive organizational practices to enhance efficiency, coordination, and accountability in public organizations. It emphasizes strategic alignment between digital infrastructure, human resources, institutional rules, and service delivery objectives (20, 21). In urban governance contexts, smart management acts as the operational backbone that translates high-level smart city strategies into concrete organizational practices and outcomes (5, 22). Therefore, understanding how smart management models can be designed and implemented within specific urban organizations is essential for advancing smart governance agendas.

One of the most critical yet underexplored domains of smart urban governance is emergency management and firefighting services. Urban fire departments operate in environments characterized by high uncertainty, time pressure, and risk, making them particularly sensitive to governance and management quality (23, 24). The increasing density of cities, vertical urban development, climate-related hazards, and complex infrastructure systems have significantly expanded the scope and complexity of firefighting missions (13, 25). As a result, traditional firefighting management approaches often struggle to meet contemporary urban safety demands.

Recent research highlights the potential of smart firefighting management systems that integrate IoT sensors, geographic information systems (GIS), real-time data platforms, and decision-support systems to enhance situational awareness, response speed, and risk prediction (11, 20). Empirical studies conducted in Iranian cities such as Mashhad, Yazd, and Rasht demonstrate that smart management approaches can significantly improve urban safety outcomes and operational efficiency in fire departments (20, 23, 24). However, these studies also reveal persistent challenges related to institutional coordination, data quality, resource constraints, and organizational readiness.

In Iran, smart urban governance has become a strategic policy priority, particularly in metropolitan areas such as Tehran. National and municipal initiatives increasingly emphasize digital transformation, e-government, and intelligent urban services as mechanisms for improving governance quality and public trust (26, 27). Scholarly work on smart governance in Iran has produced valuable conceptual models that link smart city development to good urban governance principles, including transparency, accountability, participation, and effectiveness (15, 28). Nevertheless, much of this research remains either conceptual or sector-specific, with limited empirical integration across governance dimensions.

The Tehran Firefighting and Safety Services Organization represents a strategically significant case for studying smart management and urban governance. As the primary emergency response institution in Iran's largest metropolitan area, the organization operates at the intersection of urban risk management, public safety, technological innovation, and inter-organizational coordination. The complexity of Tehran's urban structure, combined with frequent natural and human-induced hazards, underscores the need for advanced smart management solutions to enhance governance effectiveness (15, 17). Yet, despite policy emphasis on smart cities, there is a lack of comprehensive, empirically grounded models that explain how smart management can be systematically developed and implemented within firefighting organizations.

International experiences further demonstrate that smart governance outcomes are highly context-dependent. Comparative studies from Europe, Asia, and Latin America show that governance success depends on local institutional capacity, leadership styles, regulatory frameworks, and cultural acceptance of innovation (1, 29). Emerging evidence from Indonesia and other developing countries highlights the importance of aligning smart governance initiatives with organizational realities and stakeholder expectations to avoid symbolic or fragmented implementation (19, 21). These findings reinforce the need for context-specific smart management models grounded in empirical analysis.

From a theoretical perspective, the literature identifies multiple dimensions influencing smart governance, including causal drivers (policy support, urban complexity), contextual conditions (organizational culture, leadership), intervening factors (resource constraints, data quality), strategic actions (infrastructure development, collaboration), and governance outcomes (efficiency, safety, trust) (3, 6, 12). However, existing studies often examine these dimensions in isolation rather than as integrated components of a coherent management model. This fragmentation limits the practical applicability of smart governance research for urban organizations seeking systematic transformation.

Given these gaps, there is a clear need for an integrated, empirically validated smart management model that captures the complex interactions among technological, organizational, institutional, and human factors in urban governance. Such a model is particularly crucial for high-risk urban service organizations like firefighting departments, where governance effectiveness directly affects public safety and resilience (14, 25). By adopting a mixed-methods approach that combines grounded theory with structural equation modeling, it becomes possible to both conceptualize and empirically test the mechanisms through which smart management contributes to improved urban governance.

Accordingly, this study seeks to advance the literature by developing and validating a comprehensive smart management model based on innovative solutions for improving urban governance, grounded in the case of the Tehran Firefighting and Safety Services Organization, integrating causal, contextual, intervening, strategic, and outcome dimensions through a mixed qualitative–quantitative research design.

The aim of this study is to design and validate a smart management model based on innovative solutions for improving urban governance in the Tehran Firefighting and Safety Services Organization.

Methods and Materials

The present study adopts a mixed-methods (qualitative–quantitative) approach in terms of research orientation and follows a sequential exploratory qualitative strategy in terms of implementation. In the first phase, grounded theory methodology with the systematic approach of Strauss and Corbin was employed to identify and explicate a smart management model of innovative solutions for improving urban governance in the Tehran Firefighting and Safety Services Organization. This phase was based on the analysis of semi-structured Delphi interviews conducted with experts and specialists in the fields of urban management, senior managers of municipal organizations, and faculty members of universities across the country, and data collection continued until theoretical saturation was achieved. Sampling in the qualitative phase was conducted using purposive and theoretical (judgmental) sampling, and in total, approximately 30 individuals participated in the interviews.

Qualitative data analysis was carried out through three stages of open coding, axial coding, and selective coding. In this process, initial concepts were first extracted from the raw data; subsequently, categories were formed based on conceptual relationships; and finally, through selective coding, the paradigmatic research model was developed based on the dimensions of the central phenomenon, causal conditions, contextual conditions, intervening conditions, strategies, and consequences.

In the second phase of the study, a quantitative approach was employed to test and validate the extracted model. Accordingly, the categories and constructs identified in the qualitative phase were transformed into measurable items, and a questionnaire was developed using a five-point Likert scale. The statistical population of the quantitative phase consisted of senior managers of municipal organizations and faculty members of universities across the country. Due to the unknown population size, the Krejcie and Morgan table was used to determine a sample size of 384 participants, who were selected through simple random sampling from across the country.

Quantitative data analysis and testing of relationships among constructs were conducted using variance-based structural equation modeling, and the SmartPLS software was utilized to assess the goodness of fit of the research model. The spatial scope of the study was Iran, and the temporal scope covered the years 2024 to 2025. In terms of subject matter, the research focuses on presenting a smart management model of innovative solutions for improving urban governance, with a case study of the Tehran Firefighting and Safety Services Organization.

Findings and Results

This section addresses the classification and analysis of information and results obtained from the interviews. This process, in essence, involves the exploration of meanings and the conceptualization of behaviors, which constitutes one of the core characteristics of grounded theory methodology. In analyzing the qualitative data, open coding was conducted as the initial step. The output of this stage consisted of open codes and initial categories, which in some studies are referred to as secondary coding. In the axial coding stage, the initial concepts were categorized into categories, themes, or patterns. The discovered categories were then selectively classified after identifying their typological relationships. In explaining the categories and concepts, and in line with the research questions—namely, what model is appropriate for smart management of innovative solutions to improve urban governance in the Tehran Firefighting and Safety Services Organization—relevant theories and literature were also employed.

In the present study, field data collection involved interviews with 15 experts and specialists in the field of management and urban governance from both academic and executive domains. Of these, nine interviews were selected for detailed examination and coding. It should be noted that, for interview analysis, open coding was applied first, followed by axial coding.

Initially, descriptive information about the interviewees is presented.

Table 1. Descriptive Information of Interviewees

Education Level	Frequency	Field of Activity	Frequency	Years of Experience	Frequency
PhD	2	University faculty member	2	Less than 10 years	1
Master’s degree	3	Media field experts	3	10 to 20 years	3
Bachelor’s degree	3	Communication specialists	4	More than 20 years	5

The table above indicates that the majority of interviewees held master’s or bachelor’s degrees, had more than 20 years of work experience, and were primarily communication specialists.

Open coding, as the first stage of grounded theory analysis, involves breaking data into discrete parts, conceptual processing, and categorization. At this stage, the recorded interview texts were carefully transcribed and reviewed multiple times. The researcher examined the data line by line and word by word, identified the main sentences and concepts in each line or paragraph, and assigned a code to each sentence. Coding was conducted using participants’ own words or through analytical reasoning, whereby the researcher constructed codes based on the meanings embedded in the data. During open coding, an initial categorization of codes was performed, and similar codes were grouped together based on shared characteristics and dimensions. Immediately after each interview, the transcript was carefully prepared line by line by the researcher, and open coding was applied to each sentence or paragraph carrying meaning. Repeated transcription and review of interview texts guided the researcher in conducting subsequent interviews.

Overall, across the nine interviews conducted, more than 300 initial codes or concepts were extracted. In the initial coding stage, efforts were made to avoid repetition of similar codes within a single interview and across subsequent interviews. The researcher then proceeded to merge and condense the codes. Throughout the data analysis process, as additional interviews were conducted and new codes were extracted, continuous comparison was carried out between new and previous codes, and those with similar or identical meanings were grouped under a single open coding category. Accordingly, an initial classification of data was obtained, which remained subject to continuous revision and refinement until the final stages of writing the study. Moreover, irrelevant codes identified during initial coding and preliminary editing of interview texts were excluded in later revisions, and only meaningful and useful codes were retained and considered as the basis for higher-level concepts, namely the categories subjected to analysis.

Axial coding was achieved by relating and grouping the initial codes obtained. The following tables present the list of core categories along with the initial codes that led to their formation. At this stage, the main classification of data was conducted. Initial codes and categories derived from open coding were compared with one another, conceptually similar codes were merged, and they were organized around shared axes.

In the selective coding stage, the researcher focused on developing a theory regarding the relationships among the categories identified in the axial coding model. The objective of this stage was to identify the core category, integrate and relate the categories, and ultimately present a preliminary theoretical framework. This process was carried out using a paradigmatic model comprising causal conditions, contextual conditions, intervening conditions, strategies, and consequences. Although integration and synthesis occur throughout the entire analytical process from the early stages to the final presentation of theory, in selective coding the researcher concentrated specifically on identifying the core category capable of linking all other categories. The core category emerges through continuous analytical comparison and the collection of supplementary data and represents the central theme extracted from the analysis; therefore, it possesses strong explanatory power.

Table 2. Selective Coding Results

Research Dimension	Level-2 Category	Secondary Codes
Causal Conditions	Macro-level support and strategic policymaking	Political support and macro decision-making at urban and national management levels; formulation of digital policy and organizational technology governance; strategic support and commitment of senior managers; increased mission complexity due to the growth of urban crises; changes in urban patterns resulting from vertical construction; high population density and limitations of traditional management approaches; adequate financing and optimal budget allocation for programs and equipment; investment in technological infrastructure to enhance efficiency and transparency; dedicated budgets for advanced safety equipment (e.g., smoke and heat sensors); optimal station location through scientific prioritization; cultural development to support innovation and acceptance of technological change; organizational structural flexibility; advanced technical skills of human resources in using emerging technologies; training and empowerment of human resources; motivating personnel through material and non-material incentives.
Contextual Conditions	Organizational culture, structure, and transformational leadership	Organizational culture-building to support smart management and institutionalize innovation; acceptance of change as an organizational value; overcoming employee resistance through training and reducing fear of technology; acceptance of internal structural reform to adapt to emerging technologies; removal of barriers arising from bureaucratic structures; creation of a flexible organizational structure; institutional coordination among units to ensure operational integration; support and commitment of senior management to smart programs; future-oriented leadership at the top of the organization; reform of decision-making systems for smart city development; acceleration of decision-making through smart tools; required technological expertise and skills of staff and managers; training and empowerment of human resources to work with smart systems; performance-based incentive systems linked to technological outcomes; sufficient budgets and resources for smart project implementation; deployment of modern IT infrastructure (networks, systems, equipment); access to high-quality data; availability of data standards and protocols for system integration.
Intervening Conditions	Constraints, human factors, and institutional environment	Budget shortages as a primary implementation barrier; lack of specialized human resources in technology and smart management; underutilization of emerging technologies; personnel resistance to technology adoption due to habituation to traditional methods or fear of change; organizational culture as an inhibiting or facilitating factor; enhancement of employee and managerial motivation for active engagement; presence of managers with technical knowledge and capability to manage complexity; data quality for accurate decision-making; integration of unit-level information and correction of incomplete data; lack of unified technological standards hindering system compatibility; laws and regulations as constraints or enablers; weak interaction among institutions related to urban services; technology providers' quality and commitment levels; establishment of safety-technology accelerators to support startups; change management to guide organizational transformation; alignment of the model with organizational needs and operational conditions; use of emerging technologies to increase effectiveness and speed.

Development Strategies	Infrastructure development, agility, and collaboration	Development of data-driven infrastructures; upgrading hardware and software; creation of stable and secure communication networks; application of up-to-date knowledge and standards; design and implementation of early warning systems; operational agility; real-time decision-making using data and technology; establishment of a flexible organizational structure; risk management to reduce crisis impacts; creation of cultural and organizational platforms for technology adoption; development of a culture of leveraging existing technologies; utilization of internal and external innovative capacities; expansion of public education to enhance digital literacy; inter-organizational collaboration; cooperation with knowledge-based companies and startups; citizen participation in prevention and incident reporting; selection of competent experts and managers in key domains; deployment of technical solutions by specialized personnel; model sustainability through continuity of management and specialized training.
Outcomes and Results	Operational efficiency, safety, and social capital	Use of information technology for accurate decision-making; reduction of response time in emergency and firefighting operations; optimization of processes through data-driven approaches; acceleration of organizational goal achievement via digital tools; facilitation of effective responses in crises and missions; improved crisis forecasting through analysis of historical and real-time data; transition from reactive models to proactive and preventive decision-making; integration of emerging technologies in prevention and resource allocation; cost reduction through optimal resource utilization; reduction of errors in mission execution and crisis management; increased safety for personnel, citizens, and the urban environment; development of spatial and physical equity in safety and emergency service provision; enhancement of social credibility among citizens and stakeholders; increased public trust through transparency and efficiency.

According to the findings, the causal or antecedent conditions for the smart management model aimed at improving governance in the Firefighting Organization include macro-level support and strategic policymaking, environmental factors and urban changes, organizational infrastructures and resources, human and cultural capacity, and organizational innovation and health.

With regard to contextual (intra-organizational) conditions governing the smart management model for improving governance in the Firefighting Organization, these include organizational culture and acceptance of innovation, organizational structure and flexibility, transformational governance and leadership, human capacity and technological skills, and technological resources and infrastructures.

Regarding the intervening (mediating) conditions affecting the implementation process of the smart management model for improving governance in the Firefighting Organization, these include (1) resource limitations and constraints, (2) human and cultural factors, (3) infrastructures and data quality, (4) institutional and regulatory factors, and (5) innovation and model adaptability.

According to the findings, the strategies or solutions for implementing the smart management model to improve governance in the Firefighting Organization include (1) development and stabilization of smart infrastructures, (2) operational agility and enhancement, (3) institutionalization of culture and innovation, (4) institutional collaboration and synergy, and (5) merit-based selection and empowerment of human capital.

Finally, based on the findings, the core outcomes of smart management for improving governance in the Firefighting Organization include (1) operational optimization and efficiency, (2) intelligent forecasting and prevention, (3) cost savings and improved resource allocation, (4) enhancement of public safety and welfare, and (5) strengthening the organization’s position and social capital.

In order to establish the validity of the theory in this study, validation was conducted in two stages. In the first stage, the coding procedures and the resulting codes were submitted to two experts in grounded theory research for validation, and the identified issues were addressed and corrected. In the second stage, after obtaining the results, the credibility of the findings was examined. For this purpose, the results were shared with three of the interview participants, and their feedback was incorporated into the results and reviewed.

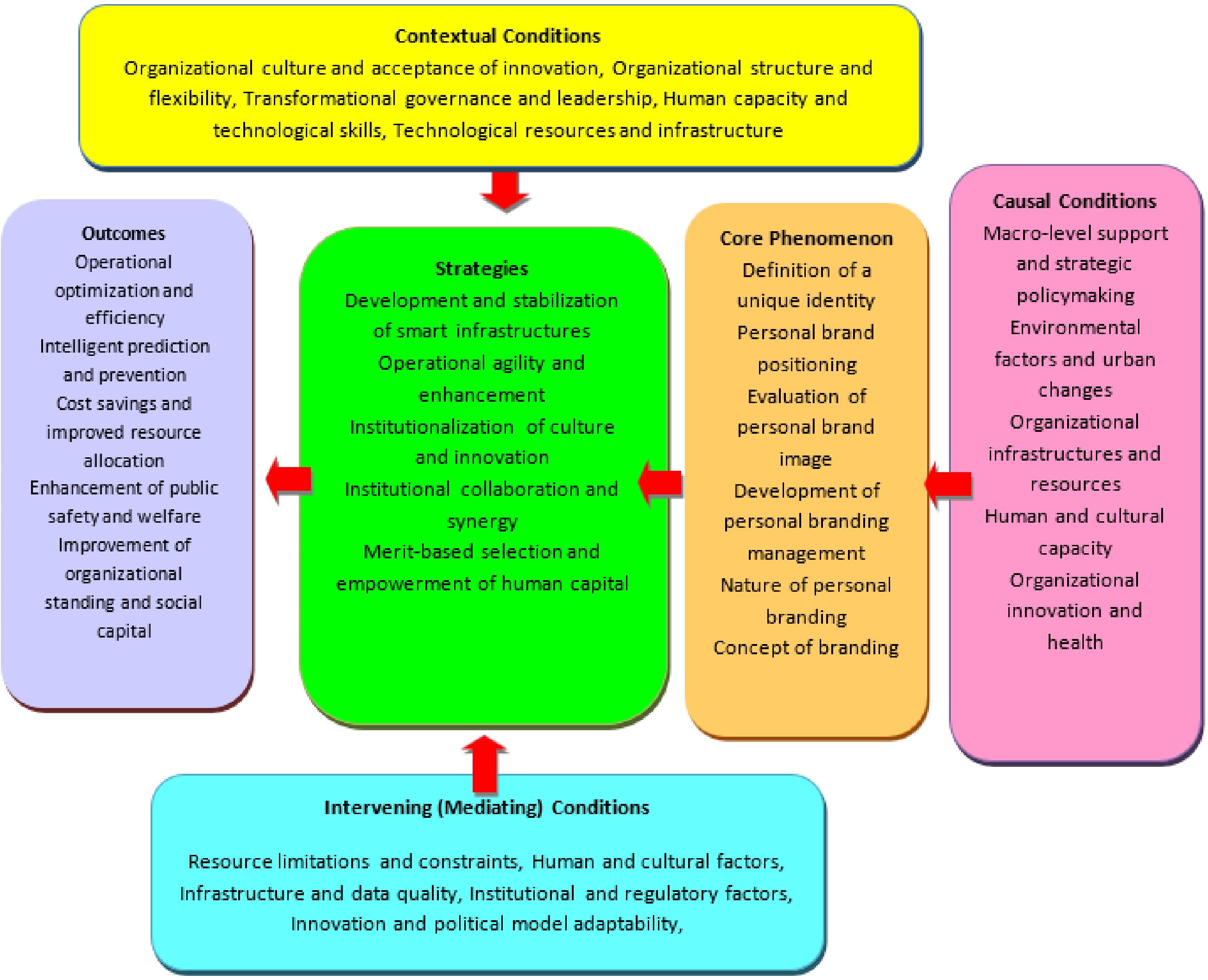

Figure 1. The paradigmatic model of Smart Management of Innovative Solutions for Improving Urban Governance: A Case Study of the Tehran Firefighting and Safety Services Organization

Data analysis for examining the confirmation or rejection of hypotheses is of particular importance in all types of research. In contemporary studies that rely on data collected from the research subject, data analysis is considered one of the most fundamental and critical components of the research process. Raw data are analyzed using statistical techniques and, after processing, are presented as meaningful information to users. In this chapter, the analysis of the collected data begins with descriptive statistics, which examine the demographic variables of the study such as gender, level of education, and similar characteristics. Subsequently, in accordance with the proposed hypotheses and the research objectives related to presenting a smart management model of innovative solutions for improving urban governance in the Tehran Firefighting and Safety Services Organization, statistical tests such as structural equation modeling were conducted using SPSS version 20 and SmartPLS software. Prior to these analyses, the Kolmogorov–Smirnov test was applied to examine the normality of the distribution of the population variables. The statistical analyses presented in Chapter Four include both descriptive and inferential analyses, which are explained sequentially.

The demographic profile of the 384 respondents indicates a highly male-dominated sample, with 373 participants (97.1%) being men and only 11 participants (2.9%) being women. In terms of age distribution, the majority of respondents were concentrated in the 30–40-year (45.3%) and 41–50-year (46.1%) age groups, while smaller proportions were under 30 years of age (3.4%) or 50 years and older (5.2%), suggesting a predominantly middle-aged workforce. Regarding work experience, most participants reported long tenure, with 32.3% having 15 years or more of experience and 28.6% having 11–15 years, whereas 22.4% had less than 5 years and 16.7% had 5–10 years of experience. In terms of educational attainment, the sample was largely composed of individuals holding a bachelor's degree (66.9%), followed by those with a master's degree (17.4%), while smaller proportions held a diploma or below (7.6%), an associate degree (7.3%), or a doctoral degree (0.8%), indicating a generally well-educated respondent group with strong professional experience.

Table 3. Measures of Central Tendency and Dispersion of the Research Variables

Statistic	Causal Conditions	Contextual Conditions	Intervening Conditions	Influential Strategies	Outcomes
Mean	4.09	3.95	4.32	3.14	3.47
Standard Deviation	0.68	0.61	0.62	0.64	0.41
Minimum Score	1.00	1.00	1.00	1.00	1.00
Maximum Score	5.00	5.00	5.00	5.00	5.00

In statistics, the standard deviation (denoted by σ) is one of the key measures of central tendency and dispersion, indicating the average distance of data points from the mean value. If the standard deviation of a dataset is close to zero, it indicates that the data points are clustered near the mean and exhibit low dispersion, whereas a large standard deviation indicates substantial dispersion of the data. The standard deviation is equal to the square root of the variance. Its advantage over variance is that it has the same unit of measurement as the data. In the study of a statistical population's distribution, the representative value around which observations are distributed is referred to as the central value, and any numerical measure representing the center of a dataset is called a measure of central tendency. The mean and median are among the most commonly used measures of central tendency. According to the results presented in Table 4-22, the mean values for causal conditions, contextual conditions, intervening conditions, influential strategies, and outcomes are 4.09, 3.95, 4.32, 3.14, and 3.47, respectively.

To examine whether the data distribution exhibits normal skewness or kurtosis, the Shapiro–Wilk test or the Kolmogorov–Smirnov test is used to ensure the normality of the data. When testing data normality, the null hypothesis—stating that the data distribution is normal—is examined at a 5% significance level. Therefore, if the test statistic yields a value greater than or equal to 0.05, there is no reason to reject the null hypothesis, and the data can be considered normally distributed. In other words, if the significance level (sig.), as reported in the Kolmogorov–Smirnov test, is greater than 0.05, the normality of the data distribution can be assumed with a high degree of confidence. Otherwise, the data distribution cannot be considered normal.

Table 4. Results of the Kolmogorov–Smirnov Test for Assessing the Normality of the Research Variables

Statistic	Causal Conditions	Contextual Conditions	Intervening Conditions	Influential Strategies	Outcomes
Kolmogorov–Smirnov Z	0.311	0.214	0.725	0.428	0.060
Significance Level (p)	0.132	0.155	0.099	0.102	0.188

According to the results presented in the above table, and given that the significance level of the test error at the 95% confidence level is greater than 0.05, it can be concluded that the distributions of the variables (causal conditions, contextual conditions, intervening conditions, influential strategies, and outcomes) are normal. Therefore, parametric tests (structural equation modeling) can be employed for hypothesis testing.

Table 5. Results of the Questionnaire Indicators

No.	Items	Mean	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
1	National macro-level policies support the implementation of smart management in the organization.	3.52	48	222	30	50	34
2	Urban strategic laws and programs provide the groundwork for developing smart systems in the fire service.	4.16	170	163	17	12	22
3	The rapid growth of Tehran and environmental changes have increased the need for smart management.	4.08	159	136	62	17	10
4	Existing technical and financial infrastructures facilitate the implementation of smart management.	4.13	203	113	19	15	34
5	The organization's staff and managers have the required capacity to adopt emerging technologies.	4.30	219	116	16	12	21
6	Organizational health and continuous innovation characterize the organization's work culture.	4.07	144	183	24	9	24
7	Organizational culture encourages the adoption of emerging technologies.	4.11	210	98	25	11	40
8	The organizational structure is flexible in adapting to technological changes.	4.30	264	51	19	21	29
9	The leadership style in the organization is transformational and innovative.	4.05	108	226	24	15	11
10	Employees possess sufficient skills to use smart technologies.	4.10	115	228	18	12	11
11	The organization's technological resources and infrastructures meet the needs of smart management development.	3.21	17	90	247	18	12
12	Lack of financial resources is a barrier to the development of smart systems.	4.32	169	188	13	10	4
13	Shortage of specialized human resources is a major challenge in implementing smart management.	4.42	224	131	12	1	16
14	Employee resistance to technological change negatively affects project progress.	4.24	191	126	51	3	13
15	Poor data quality limits the effective use of smart systems.	4.64	280	89	2	8	5
16	Inefficient regulations and administrative structures slow down the implementation of smart management.	4.46	219	148	7	7	6
17	Teachers are familiar with changes and updates in educational content.	3.82	79	184	107	4	10
18	The development of smart infrastructures should be pursued sustainably.	2.56	52	14	111	129	78
19	Increasing operational agility plays an important role in the success of smart management.	2.97	12	57	233	75	7
20	Institutionalizing a culture of innovation among employees is essential for the success of smart management.	4.08	78	286	4	7	9
21	Inter-organizational cooperation and institutional synergy increase the effectiveness of smart management.	3.60	81	219	7	5	72
22	Merit-based selection and empowerment of human capital are key strategies for successful implementation.	2.47	107	27	5	49	196
23	Smart management leads to process optimization and increased operational efficiency.	4.09	130	215	9	7	23
24	Smart systems improve the prediction and prevention of incidents.	2.46	14	4	198	98	70
25	The use of smart management leads to resource savings.	4.33	167	193	11	10	3
26	This approach increases the level of public safety and welfare.	2.12	5	61	56	118	144
27	The implementation of smart management enhances the organization's social standing and public trust capital.	4.00	50	312	8	1	13
28	Smart management leads to process optimization and increased operational efficiency.	3.83	102	224	3	4	51

According to the results presented in the above table, based on the mean values as well as the percentages and frequencies of the questionnaire indicators, the highest-rated indicator is *"Poor data quality limits the effective use of smart systems,"* while the lowest-rated indicator is *"This approach increases the level of public safety and welfare."*

The results of reliability assessed through item–total correlations, item reliability, convergent validity, and discriminant (divergent) validity of the extracted constructs based on the final model are presented in the following tables.

Table 6. Reliability and Convergent Validity Analysis of the Smart Management Model of Innovative Solutions for Improving Urban Governance

Variables	Items	Item Reliability	Item–Total Correlation	Cronbach's Alpha	AVE	CR
Causal Conditions	Item 1	0.70	0.54	0.73	0.49	0.85
	Item 2	0.73	0.58			
	Item 3	0.68	0.54			
	Item 4	0.68	0.57			
	Item 5	0.70	0.57			
	Item 6	0.70	0.57			
Contextual Conditions	Item 7	0.72	0.54	0.70	0.54	0.89
	Item 8	0.71	0.50			
	Item 9	0.75	0.56			
	Item 10	0.75	0.56			
	Item 11	0.78	0.57			
Intervening Conditions	Item 12	0.73	0.58	0.86	0.54	0.88
	Item 13	0.70	0.50			
	Item 14	0.73	0.57			
	Item 15	0.74	0.54			
	Item 16	0.75	0.57			
	Item 17	0.73	0.58			
Influential Strategies	Item 18	0.73	0.56	0.70	0.56	0.89
	Item 19	0.74	0.52			
	Item 20	0.73	0.55			
	Item 21	0.75	0.54			
	Item 22	0.73	0.55			
Outcomes	Item 23	0.73	0.56	0.75	0.55	0.93
	Item 24	0.73	0.54			
	Item 25	0.74	0.57			
	Item 26	0.75	0.58			
	Item 27	0.73	0.56			
	Item 28	0.75	0.58			

The results reported in the above table indicate that the item–total correlation coefficients are greater than 0.30 and that item reliability values exceed 0.50, demonstrating sufficient precision of the questionnaire items used to design the smart management model of innovative solutions for improving urban governance. In addition, Cronbach's alpha coefficients are higher than 0.60 and composite reliability (CR) values exceed 0.70, indicating that all five factors possess adequate reliability. Furthermore, the results show that for each construct CR > AVE and AVE > 0.50; therefore, the components demonstrate acceptable convergent validity.

In partial least squares analysis, discriminant validity—which reflects the presence of partial correlations between indicators of one construct and indicators of other constructs—is assessed using the Fornell–Larcker criterion. This criterion states that the square root of the average variance extracted (AVE) for each construct should be greater than its correlations with other constructs. Accordingly, the values on the main diagonal of the matrix must be greater than all corresponding values in the related column. Table 4-27 presents the Fornell–Larcker matrix for the smart management model of innovative solutions for improving urban governance.

Table 7. Fornell–Larcker Matrix for the Smart Management Model of Innovative Solutions for Improving Urban Governance

Variable	Causal Conditions	Contextual Conditions	Intervening Conditions	Influential Strategies	Outcomes
Causal Conditions	1.44				
Contextual Conditions	0.88	1.31			
Intervening Conditions	0.70	0.74	1.29		
Influential Strategies	0.68	0.73	0.75	1.17	
Outcomes	0.60	0.71	0.72	0.99	0.80

As shown, the values on the main diagonal of the matrix are greater than all corresponding values in their respective columns, indicating that the model demonstrates adequate discriminant validity. These findings indicate that all five factors adequately capture the intended construct of the questionnaire—namely, the smart management model of innovative solutions for improving urban governance (convergent validity)—and that the subscales are not so highly correlated as to collapse into a single construct; therefore, the components are not redundant (divergent validity).

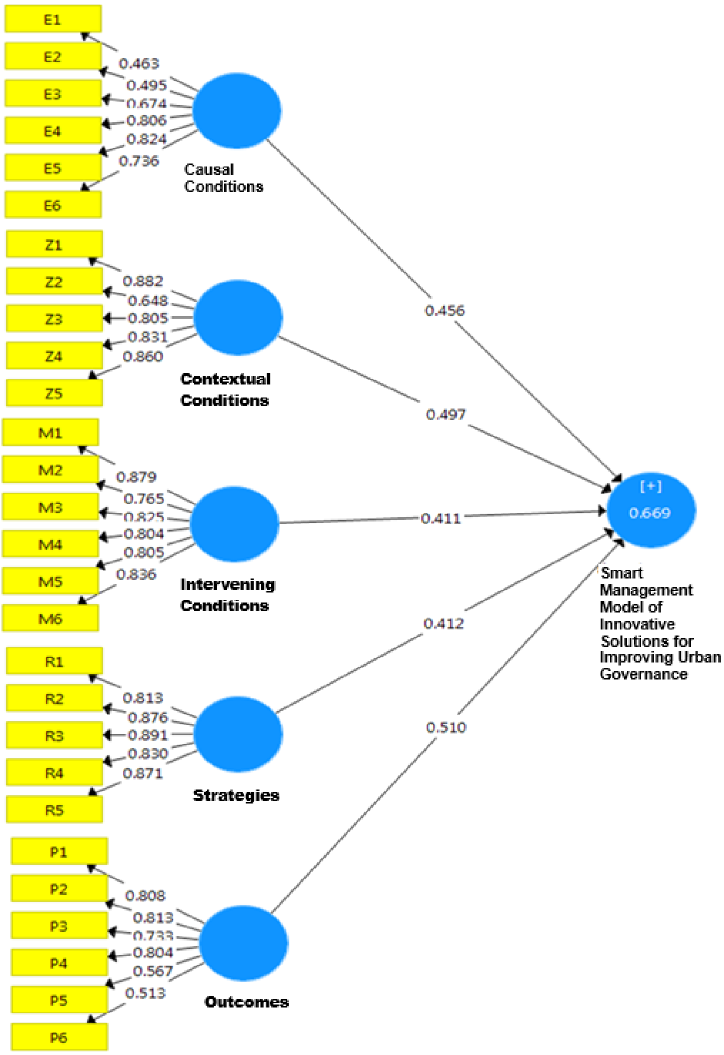

Figure 2. Testing the research model (standardized coefficients)

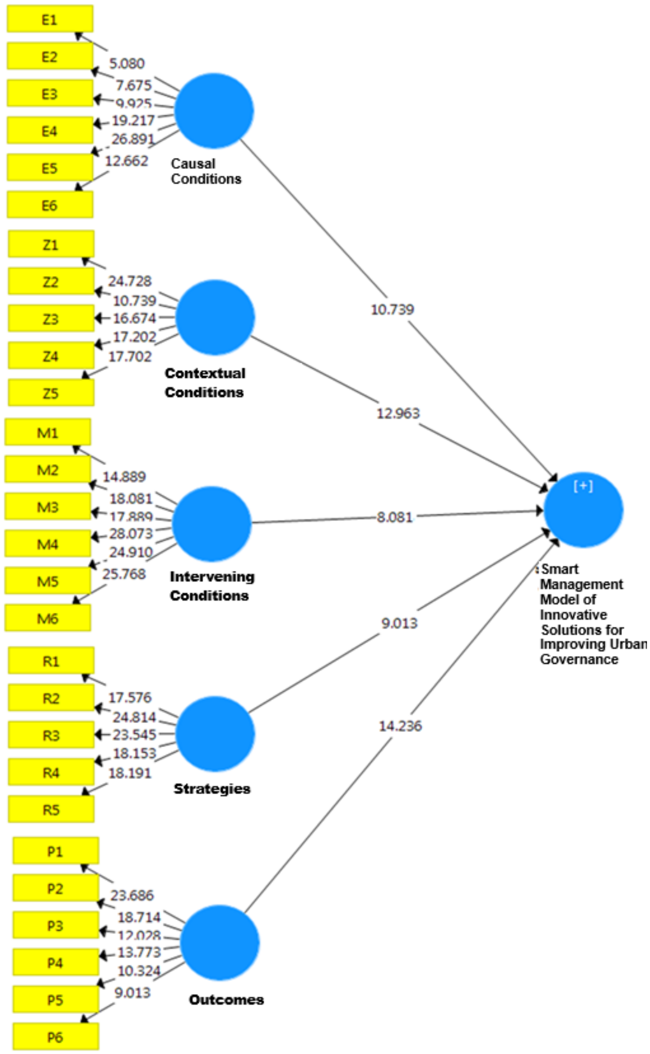

Figure 3. Testing the research model (significance coefficients)

The most fundamental criterion for examining relationships among constructs in the structural model is the t-statistic. In fact, the model tests all measurement equations (factor loadings) and structural equations (path coefficients) using the t-statistic. According to this model, if the t-statistic for a given path exceeds 1.96, the path coefficient and factor loading are significant at the 95% confidence level. If the t-statistic is less than 1.96, the factor loading or path coefficient is not significant. Moreover, if the t-statistic exceeds 2.58, the path coefficient and factor loading are significant at the 99% confidence level. As shown in the model testing results (significance coefficients), all t-statistic values exceed 2.58, indicating that all factor loadings and path coefficients are statistically significant.

The values inside the ellipses represent the coefficient of determination. The coefficient of determination (R^2) examines the proportion of variance in a dependent variable explained by the independent variables. Naturally, this value equals zero for independent variables and is greater than zero for dependent variables. The higher the R^2 value, the stronger the explanatory power of the independent variables on the dependent variable.

As shown in Figure 2, given that the R^2 value for the smart management model of innovative solutions for improving urban governance is approximately 0.669, this result indicates that about 69% of the variance in the smart management model of innovative solutions for improving urban governance is explained by its influencing factors. In this study, the obtained R^2 values are presented in the following table.

Table 8. Coefficients of Determination (R^2)

Coefficient of Determination (R^2)	Variable
0.669	Smart Management Model of Innovative Solutions for Improving Urban Governance

Table 9. Summary of Hypothesis Testing Results

Research Question / Hypothesis Dimension	Target Construct	Standardized Path Coefficient	t-Statistic	p-Value	Decision	Research Question Addressed
Causal Conditions	Smart Management Model of Urban Governance	0.456	10.739	$p < 0.05$	Supported	What causal conditions influence the smart management model of innovative solutions for improving urban governance in the Tehran Firefighting and Safety Services Organization?
Contextual Conditions	Smart Management Model of Urban Governance	0.497	12.962	$p < 0.05$	Supported	What contextual conditions influence the smart management model of innovative solutions for improving urban governance in the Tehran Firefighting and Safety Services Organization?
Intervening Conditions	Smart Management Model of Urban Governance	0.411	8.081	$p < 0.05$	Supported	What intervening conditions influence the smart management model of innovative solutions for improving urban governance in the Tehran Firefighting and Safety Services Organization?
Influential Strategies	Smart Management Model of Urban Governance	0.412	9.013	$p < 0.05$	Supported	What strategies influence the smart management model of innovative solutions for improving urban governance in the Tehran Firefighting and Safety Services Organization?
Outcomes of Implementation	Smart Management Model of Urban Governance	0.510	14.236	$p < 0.05$	Supported	What are the outcomes of implementing the smart management model of innovative solutions for improving urban governance in the Tehran Firefighting and Safety Services Organization?

The integrated results of structural equation modeling indicate that all five hypothesized dimensions—causal conditions, contextual conditions, intervening conditions, influential strategies, and outcomes—have statistically significant effects on the smart management model of innovative solutions for improving urban governance in the Tehran Firefighting and Safety Services Organization ($p < 0.05$). Among these, the strongest effect is observed for the outcomes of implementation ($\beta = 0.510$, $t = 14.236$), highlighting the central role of operational, safety, and governance-related consequences in validating the model. Contextual conditions ($\beta = 0.497$, $t = 12.962$) and causal conditions ($\beta = 0.456$, $t = 10.739$) also demonstrate strong explanatory power, emphasizing the importance of organizational environment, leadership, policy support, and structural readiness. Intervening conditions ($\beta = 0.411$, $t = 8.081$) and influential strategies ($\beta = 0.412$, $t = 9.013$) further confirm that resource constraints, human and institutional factors, as well as strategic actions, play meaningful roles in shaping the effectiveness of smart management. Overall, the findings provide robust empirical support for the proposed model and confirm that its theoretical components collectively and significantly explain the dynamics of smart urban governance within the studied organization.

Discussion and Conclusion

The findings of the present study provide strong empirical support for the proposed smart management model based on innovative solutions for improving urban governance in the Tehran Firefighting and Safety Services Organization. Overall, the results demonstrate that smart management is a multidimensional construct shaped by causal conditions, contextual conditions, intervening factors, strategic actions, and governance outcomes, all of which exert statistically significant and meaningful effects on the effectiveness of urban governance. This integrated perspective aligns with contemporary smart governance literature, which emphasizes that successful smart city initiatives depend not merely on technological deployment but on the coherent interaction between institutional, organizational, human, and technological dimensions (2-4).

With respect to causal conditions, the findings indicate that macro-level policy support, strategic decision-making, urban complexity, and organizational resources play a critical role in shaping the smart management model. The significant path coefficient associated with causal conditions highlights the importance of national and municipal policy alignment, financial support, and infrastructural readiness in enabling smart governance. This result is consistent with studies emphasizing that smart governance initiatives require strong political will and policy coherence to overcome fragmentation and implementation barriers (1, 26). In the Iranian context, previous research has similarly shown that the absence of integrated policy frameworks can undermine the effectiveness of smart city programs, particularly in large metropolitan areas such as Tehran (15, 28). The present findings therefore reinforce the argument that smart management must be grounded in supportive governance structures at higher decision-making levels to ensure sustainability and scalability.

The results related to contextual conditions further underscore the central role of internal organizational factors, including culture, leadership, structural flexibility, and human capacity. The strong and significant effect of contextual conditions suggests that even when external policies and resources are available, the success of smart management depends heavily on organizational readiness and adaptability. This finding aligns closely with the smart governance literature, which identifies organizational culture and leadership as key enablers of digital transformation and innovation in public organizations (5, 8). Empirical studies in both developed and developing countries indicate that transformational leadership and a culture that embraces innovation significantly enhance the effectiveness of smart governance initiatives (9, 21). In line with these studies, the current research demonstrates that the Tehran Firefighting and Safety Services Organization’s capacity to internalize smart management principles is closely linked to its internal governance environment.

Intervening conditions, including resource limitations, human resistance, data quality, and regulatory constraints, were also found to exert a significant influence on the smart management model. These findings highlight the role of mediating factors that can either facilitate or hinder the translation of smart management strategies into tangible governance outcomes. Prior research has consistently pointed to issues such as budget constraints, lack of skilled personnel, fragmented data systems, and rigid administrative regulations as major obstacles to smart governance implementation (6, 13). In firefighting and emergency management contexts, these challenges are particularly pronounced due to the operational complexity and high-risk nature of activities (23, 24). The present study extends this body of knowledge by empirically demonstrating that intervening conditions significantly shape the effectiveness of smart management, emphasizing the need for targeted interventions to address these barriers.

The analysis of influential strategies reveals that strategic actions such as developing smart infrastructures, enhancing operational agility, institutionalizing innovation, fostering inter-organizational collaboration, and empowering human capital are critical drivers of smart governance. The significant relationship between strategic actions and the smart management model confirms that smart governance is not an automatic outcome of technological availability but rather the result of deliberate and coordinated managerial strategies. This finding resonates with prior studies that stress the importance of strategic integration and cross-sector collaboration in smart city initiatives (7, 22). In the context of emergency and firefighting services, the adoption of data-driven early warning systems, real-time decision-making tools, and collaborative platforms has been shown to substantially improve response efficiency and risk mitigation (11, 20). The present results corroborate these insights and demonstrate their relevance within the governance framework of Tehran's firefighting organization.

Among all dimensions, the outcomes of implementing smart management exhibited the strongest effect on the overall model. This finding indicates that improvements in operational efficiency, predictive and preventive capabilities, resource optimization, public safety, and organizational legitimacy are central to validating smart governance initiatives. The prominence of outcomes reflects the practical orientation of smart management, where governance reforms are ultimately judged by their tangible benefits for citizens and stakeholders. This result is consistent with the literature emphasizing that smart governance should enhance public value, trust, and service quality rather than merely introducing new technologies (4, 29). Empirical evidence from smart city pilot projects further supports the conclusion that visible performance improvements are essential for sustaining political and public support for smart governance reforms (10, 14).

Taken together, the findings of this study contribute to the smart governance literature in several important ways. First, they provide an empirically validated, integrated model that captures the complex interplay between structural, contextual, mediating, strategic, and outcome dimensions of smart management. Second, they extend existing research by focusing on a critical yet underexamined domain—urban firefighting and safety services—where governance effectiveness has direct implications for urban resilience and public welfare. Third, the study contextualizes global smart governance theories within the specific institutional, cultural, and operational realities of Tehran, thereby addressing calls for context-sensitive smart city research (3, 30). Overall, the results confirm that smart management can serve as a powerful mechanism for improving urban governance when it is strategically designed, institutionally supported, and organizationally embedded.

Despite its contributions, this study has several limitations that should be acknowledged. First, the research is based on a single case study of the Tehran Firefighting and Safety Services Organization, which may limit the generalizability of the findings to other urban organizations or cities with different institutional and cultural contexts. Second, although a mixed-methods approach was employed, the quantitative data relied on self-reported perceptions of managers and experts, which may be subject to response bias. Third, the cross-sectional nature of the quantitative phase restricts the ability to capture dynamic changes in smart management practices and governance outcomes over time. Finally, some contextual variables, such as political dynamics and external stakeholder pressures, could not be fully explored within the scope of the study.

Future research could extend this study in several directions. Comparative studies across multiple cities or emergency service organizations could help assess the transferability and robustness of the proposed smart management model. Longitudinal research designs would be valuable for examining how smart management initiatives evolve over time and how their governance impacts unfold in different phases of implementation.

Additionally, future studies could integrate objective performance indicators, such as response times, incident outcomes, and cost-efficiency metrics, to complement perceptual data. Finally, exploring the role of emerging technologies such as artificial intelligence and advanced analytics in greater depth could further refine smart management frameworks for urban governance.

From a practical perspective, urban policymakers and managers should prioritize the alignment of smart management initiatives with macro-level policies and secure sustained political and financial support. Organizational leaders should invest in building a culture of innovation, flexibility, and continuous learning to enhance readiness for smart governance. Addressing intervening barriers, particularly data quality issues and human resource capacity, should be treated as a strategic priority rather than a technical afterthought. Finally, urban firefighting and safety organizations should adopt a holistic approach to smart management that integrates technology, strategy, and governance to achieve measurable improvements in public safety, efficiency, and trust.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adheried in conducting and writing this article.

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.

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