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Assessing the feasibility of smart city indicators in qazvin: challenges and opportunities for sustainable urban development

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Abstract

This study conducts a comprehensive investigation into the potential for Qazvin, Iran, to transition into a smart city. It meticulously assesses the feasibility and implementation of various smart city indicators, which encompass critical domains such as smart transportation systems, efficient waste management practices, sustainable energy solutions, robust technological infrastructure, and active citizen engagement mechanisms. Employing a mixed-methods research design, the study integrates both qualitative and quantitative methodologies, utilizing extensive literature reviews and structured surveys to gather insights from urban management experts who possess relevant knowledge and experience in city planning and smart technologies. The findings of this research provide valuable insights into the current state of Qazvin, revealing that the city exhibits notable strengths in areas such as citizen engagement initiatives and a heightened level of environmental awareness among its residents. However, the study also identifies significant challenges that hinder the effective implementation of smart technologies and the establishment of best governance practices. These challenges include infrastructural deficits, resource limitations, and the need for enhanced collaboration among various stakeholders. Furthermore, the research underscores the critical importance of developing comprehensive policy frameworks and engaging in long-term strategic planning. Such measures are essential not only to address the existing challenges but also to maximize the potential of Qazvin's rich cultural and historical resources, thereby fostering sustainable urban development. Ultimately, the results of this study aim to provide actionable insights and recommendations for policymakers and city managers as they work towards creating a more intelligent and sustainable urban environment, equipped to meet the future needs of its citizens.

Keywords: Smart City; Qazvin; Urban development; Sustainability; Citizen Engagement; Smart Indicators; Technology Integration

1. Introduction

The European Commission defines a "smart city" as one that leverages digital technologies to enhance existing networks and services for the benefit of residents and businesses. This concept extends beyond efficient resource management and pollution reduction to include improved water distribution, waste collection, advanced urban transport systems, and energy-efficient lighting and heating in both commercial and residential areas. A smart city also fosters a more engaged and responsive municipality, enhances public safety in communal spaces, and addresses the needs of an aging population (1). Kinelski describes the smart city concept as encompassing innovative, social, technical, and economic development capacities (2). Similarly, Khatun and Zadali characterize a smart city as an advanced urban area that caters to the needs of organizations, institutions, and especially its residents (3). Policies in smart communities are critical for leveraging technology to create innovation networks, improve community well-being, and stimulate vibrant economies. These policies also tackle sustainability and urban development challenges, providing solutions to pressing issues. Although these goals are ambitious, they represent essential strategies for urbanization that require significant investments and long-term planning. Therefore, comprehensive research at both policy formulation and implementation stages is essential. Smart cities should be designed to produce meaningful impacts on urban, economic, and social development, warranting further investigation in this field (4). Kinesis introduced the "Smart City Cycle" index, which evaluates smart cities across dimensions such as environment, mobility, governance, economy, people, and quality of life (2). This index serves as a foundational framework for numerous international studies on smart city indicators.

Qazvin, with its rich history, culture, and diverse resources, has significant potential to evolve into a smart city. However, to implement smart city indicators effectively, a thorough assessment of the city's current status is necessary, identifying both challenges and opportunities while proposing suitable strategies. This research explores the feasibility of various smart city indicators in Qazvin, including smart transportation, waste management, sustainable energy, technological infrastructure, and citizen engagement. As one of Iran's historically significant cities, Qazvin possesses abundant potential in economic, cultural, and tourism sectors, positioning it as a promising candidate for smart city development. Realizing this potential requires an in-depth

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analysis of smart city indicators and their implementation feasibility. This study aims to identify Qazvin's strengths and weaknesses in its smart city journey and offer practical solutions for achieving these indicators. By examining and measuring these indicators, the research evaluates the extent to which Qazvin has realized its smart city goals. The findings are intended to assist policymakers and city managers in making informed decisions, ultimately paving the way for sustainable and intelligent development in Qazvin.

While quantitative assessments provide valuable snapshots of perceived progress, this study acknowledges the inherent complexity of urban systems transcending purely statistical measures. Recognizing this, our research aims to bridge empirical data with actionable insights for urban governance. We position this work not as a definitive architectural or planning blueprint, but as a "policy-oriented feasibility assessment" identifying leverage points and barriers within Qazvin's specific socio-technical context. The contribution lies in translating expert perceptions on key smart city dimensions into targeted recommendations for strategic intervention within Iran's unique urban management frameworks, thereby informing practical pathways towards sustainable smart urban development.

2. Research Background

2.1. Overview of smart cities: concepts and characteristics

Smart cities have garnered significant attention and investment globally in recent years, leading to numerous projects and initiatives. However, there is no universally accepted definition of a smart city (5). This ambiguity poses challenges for policymakers, urban planners, and stakeholders involved in developing and implementing smart city initiatives. While it is challenging to provide a concise definition, various researchers highlight specific characteristics that can enhance understanding of the smart city concept. Deakin describes a smart city as one that utilizes information and communication technology to meet the market demands of its citizens (6). Similarly, Khatun and Zadali define it as "an ultra-modern urban area that fulfills the needs of businesses, institutions, and particularly citizens," distinguishing the broad concept of smart cities from the narrower idea of smart urbanism, which encompasses information and communication technologies (3). Giffinger et al. from Vienna University of Technology identified six key characteristics of a smart city: smart mobility, smart people, smart living, smart governance, smart environment, and smart economy (7). These characteristics illustrate that a smart city effectively integrates governance, citizen engagement, economic activities, environmental management, and mobility to enhance the urban experience. Jansen further refine the definition, characterizing a smart city as one that employs technology to transform its core systems and optimize efficiency (8). The concept of the smart city has been evolving for about 30 years, focusing on exploring and identifying innovative solutions that improve the quality of services provided to citizens (9). Despite the growing interest and numerous initiatives, our structured literature review highlights that the term "smart city" is often replaced or interpreted through various descriptors like "intelligent" or "digital" (10). This has contributed to the term's ambiguity and complexity, with inconsistent applications across different contexts. While many smart city initiatives emphasize sustainability, efficiency, and quality of life (11), the lack of a universal definition reflects the diverse ideas and initiatives encompassed by the term, which vary according to geographical and socio-economic contexts (12). The emphasis on technology underscores the essential tools for implementing smart city projects. However, despite the prevalence of these themes, a consistent definition remains elusive. A compilation of definitions used in this analysis is presented in Table 2 below.

2.2. Realizability of smart cities

The realization of smart cities depends on the comprehensive integration of strategies across all urban dimensions. Various challenges can be categorized into four main areas: technological, policy, management, and contextual issues (13). Additionally, smart cities face inherent risks, as their development often involves new and untested experiments. Potential issues include incompatibility between legacy systems and new technology, insufficient knowledge about these emerging technologies, and unrealistic expectations regarding their implementation.

Beyond technical, political, and managerial challenges, Ojo and colleagues emphasize the importance of stakeholder engagement and investment participation. Support for investment decisions and securing funding are complex tasks (14).

2.3. Feasibility of smart cities in europe

In 2014, the European Parliament and the Committee on Energy and Research initiated a report assessing smart cities within the European Union. This report surveyed 468 cities with populations exceeding 100,000, identifying approximately 240 of them as smart cities. The evaluation focused on six components: smart environment, smart mobility, smart governance, smart living, smart economy, and smart people.

Analysis of these 240 cities revealed that the smart environment component received the most attention, being prioritized by 199 cities. The components are ranked based on their popularity among European cities as follows:

1. Smart environment
2. Smart mobility
3. Smart governance
4. Smart living
5. Smart economy
6. Smart people

From these findings, it is evident that the economic component and engagement with citizens have historically received less attention. As a result, there has been a growing focus on enhancing these two dimensions of smart cities in recent years (15).

Table 1
Smart City Definitions

Definition	References
A smart city is capable of identifying its challenges and addressing their root causes by generating and processing high-quality data within a continuous and comprehensive framework.	(16)
It is defined as a city that utilizes information and communication technology (ICT) to meet the needs of its citizens. This ultra-modern urban area aims to fulfill the requirements of its residents.	(5)
In the architecture of a smart city, ICT enhances both living standards and management practices for citizens and government alike.	(17)
The concept revolves around creating a sustainable living environment through the integration of advanced technologies.	(18)
A smart city focuses primarily on improving the quality of life for its inhabitants, balancing economic, environmental, and social developments through the widespread adoption of ICT and other technological tools.	(19)
Such a city optimally leverages interconnected information to better understand and manage its operations while efficiently utilizing limited resources.	(20)
Smart cities employ informatics and urban technologies to deliver urban services on a broader scale, enhancing quality of life and offering innovative services in areas like energy, transportation, and healthcare.	(21)
These cities incorporate smart technologies that intelligently and collaboratively improve residents' quality of life, promote sustainability, and function as resource-efficient ecosystems.	(22)
By utilizing sensor technology and intelligent systems, a smart city can achieve automated, real-time operations and gain comprehensive insights into urban functions based on a digital framework.	(23)
Ultimately, a smart city connects physical, IT, social, and business infrastructures to harness the collective intelligence of the urban environment.	(12)

3. Research Methodology

This research is classified as applied developmental research, focusing on specific questions and employing both library and survey methods. Library and document studies were utilized to gather descriptive data, while analytical data were collected through a survey method using a questionnaire. The survey tool included an electronic questionnaire based on a five-point Likert scale, ranging from "very bad" (score of 1) to "very good" (score of 5). This questionnaire was distributed to respondents via virtual networks. Its validity was confirmed by professors, and a Cronbach's alpha coefficient of 92.2% indicated high reliability.

The study's statistical population consists of experts in management, planning, and implementation within various institutions related to the city of Qazvin. A combination of cluster sampling and supervised network snowball sampling methods resulted in 385 completed questionnaires from executive experts across departments, institutions, organizations, and companies in Qazvin.

For data analysis, 34 items were examined within the framework of six components of smart cities: smart people, smart environment, smart living, smart economy, smart governance, and smart mobility, based on theoretical research. Descriptive statistical methods were employed to classify raw scores, create frequency distribution tables, and calculate dispersion indices such as mean and standard deviation. Inferential statistical methods were then used to test hypotheses. The normality of the distribution was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Since the P-value was greater than 0.05, the sample was determined to have a normal distribution. Subsequently, one-sample t-tests, Friedman ranking, and mean calculations were performed using SPSS software to analyze the statistical data.

4.1. Research positioning and methodological rationale

This study adopts a quantitative, perception-based approach to assess the feasibility and current state of smart city indicators in Qazvin. While qualitative methods offer deep contextual insights, a structured quantitative survey enables systematic benchmarking across the six established smart city dimensions and facilitates prioritization based on perceived strengths and weaknesses from those actively involved in the city's management (7). The target population comprised experts within Qazvin's urban management ecosystem precisely because their operational experience provides a grounded perspective on implementation realities and constraints. The sample size (n=385) was determined to ensure sufficient representation across the diverse institutions involved in Qazvin's governance and service delivery, acknowledging the distributed nature of urban management responsibilities. We recognize that this methodology captures expert perceptions and identifies systemic trends; it is not intended to replace detailed architectural or urban design studies, but rather to provide a strategic, evidence-based foundation upon which such specialized planning can be effectively prioritized and

contextualized for Qazvin's unique challenges and opportunities.

4.2. Introduction to the study area

Qazvin, the capital of Qazvin province, is situated in central Iran, bordered by Gilan and Mazandaran provinces to the north, Zanjan and Hamedan to the west, Markazi province to the south, and Alborz province to the east. Recognized as one of the leading cities in Iran for information technology and smart cities, Qazvin has yet to achieve significant advancements in this domain, similar to many other cities in the country. Located at an elevation of 1,278 meters above sea level, Qazvin has a rich history that dates back to the Sassanid era, flourishing under the reign of King Shapur. Historically, it served as an essential stop along the Silk Road, facilitating trade and the movement of goods between the east and west. During the Safavid period, Qazvin was Iran's capital for 57 years, which contributed to its wealth of historical sites and museums. Notably, Qazvin is home to 21% of the nation's registered national historical monuments, showcasing its cultural and historical significance.

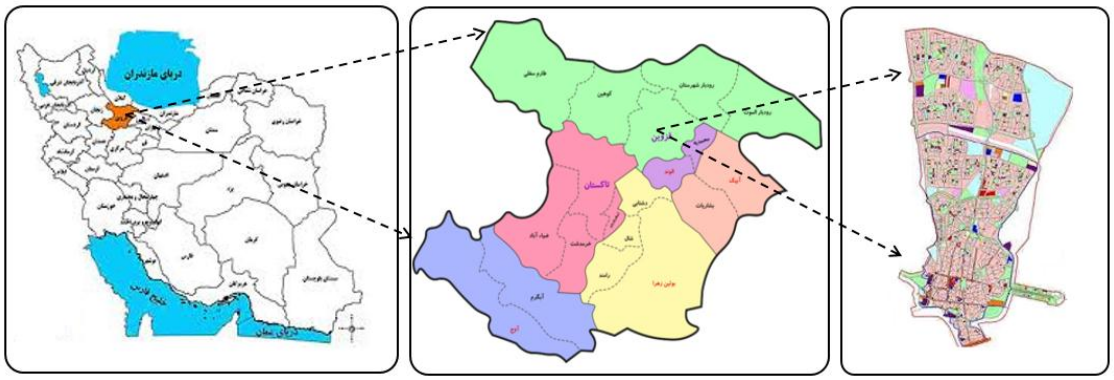

Fig. 1. Geographical location of qazvin city (study area)

5. Results and Discussion

According to the 2016 Population and Housing Census, Qazvin city has a population of 402,748 residents. The city is divided into five regions, ten districts, and 52 neighborhoods based on the latest administrative divisions. In the present study, a questionnaire consisting of 34 specialized questions related to the criteria for a smart city was developed to evaluate Qazvin, with responses gathered from 388 experts working in urban executive institutions (Table 2 & 3).

Table 2
Demographic information of Qazvin city

Variable	dimensions	Frequency	Percentage	sum of frequency
Gender	Female	145	37.37	388
	Male	243	62.63	
Age	20 to 30 years old	88	22.68	388
	30 to 40 years old	157	40.47	
	40 to 50 years old	78	20.10	
	50 years old and above	65	16.75	
Education Level	Diploma and Post-Diploma	67	17.27	388
	Bachelor	181	46.65	
	Master	102	26.29	
	PhD	38	9.79	

Table 3
Smart City Indicators and Items

Row	Indicator	Subcategory	Item
1	Smart People	Providing a higher level of knowledge and education for citizens regarding urban laws and social interactions - Increasing urban services through virtual spaces - Enhancing citizen participation in social life,	Level of citizen knowledge regarding urban management laws / Status of virtual and distance education for increased awareness among citizens / Provision of educational services using information technology / Reading habits of citizens / Willingness of citizens to participate in city council elections / Citizen involvement in urban planning initiatives / Participation of citizens in planning and decision-making when city managers

		planning, and decision-making	trust them
2	Smart Environment	Preservation and maintenance of natural resources and the environment – Utilizing renewable energy – Preventing water pollution and environmental degradation	Level of citizen participation in environmental protection / Percentage of population covered by the urban sewage system / City's status in terms of optimal use of renewable energy / Efficient energy consumption using new technologies in personal homes / Intelligent protection of natural and sensitive environmental resources
3	Smart Living	Level of citizen satisfaction - Increased personal and online safety - Improving the quality of the health system - Level of urban activity interactions - Enhancing the quality of online education	Security in both online and physical environments for citizens / Quality of the health system in the city / Smart tourism facilities and awareness of tourist attractions / Smart and online management of education quality / Willingness of citizens to follow city council resolutions / Status of hospitals in terms of smart capabilities / Connectivity of government offices and organizations to the smart network
4	Smart Mobility	Accelerating transportation using smart technologies - Access to services and information technology - Improving and enhancing transport safety	Status of smart traffic signals / Level of use of non-motorized and safe vehicles or green transportation / Encouragement from city managers to avoid personal vehicles in favor of walking / Access to smart information and communication technologies like Wi-Fi throughout the city / Traffic management capabilities for relevant organizations through smart urban systems
5	Smart Government	Citizen participation in urban decision-making - Improving online financial and administrative services	Level of smart urban services available in the city / Opportunities for citizens to participate electronically and online in government decision-making / Citizen satisfaction with efforts against corruption and crime / Availability of online financial and administrative services in the city / Status of electronic banking in the city
6	Smart Economy	Entrepreneurial opportunities through information and communication technology - Competitiveness of businesses in the online space - Improving online shopping services through virtual platforms	Level of citizen access to job and employment opportunities through information and communication technology / Use of electronic tools for shopping / Status of product offerings by local businesses through virtual and smart platforms / Public reception of online shopping / Impact of advertising networks and channels in the virtual space on product sales and distribution

As shown in Table 4, the six main indicators of a smart city, as defined by Giffinger et al., were further divided into subcategories and items for this study. The questionnaire was designed to assess the presence or absence of each of these items. Table 4 (SPSS software output) indicates that the calculated Cronbach's alpha coefficients are above 0.8 for all items, demonstrating the high reliability of the questionnaire.

Table 4
Cronbach's alpha values for research variables

Variable	Number of Questions	Cronbach's Alpha
Smart People	7	0.897
Smart Environment	5	0.897
Smart Living	7	0.887
Smart Mobility	5	0.896
Smart Government	5	0.896
Smart Economy	5	0.906
Smart Water Supply Network	9	0.920
Overall Cronbach's Alpha for All Questionnaire Items		0.922

1. Smart People

Based on responses to this index, the average rating was one of the most common answers. Analysis reveals that respondents feel citizens are not adequately involved in urban planning. If city managers trust and engage citizens in the planning and decision-making processes, the momentum toward creating a smart city will improve significantly, reflecting the high literacy and cultural engagement of the population (Table 5).

Table 5
Smart People

Item	Mean Responses	Significance Range
Level of citizens' knowledge in Qazvin regarding urban management laws	3.14	Fairly Desirable
Status of virtual and distance education for increasing citizen awareness	2.93	Desirable
Provision of educational services using information technology	3.11	Fairly Desirable
Reading habits of citizens	3.06	Fairly Desirable
Willingness of citizens to participate in city council elections	3.15	Fairly Desirable
Level of citizen involvement in urban planning initiatives	1.97	Undesirable
Citizen participation in planning and decision-making when city managers are trusted	4.23	Fairly Desirable
Overall Average	3.08	Fairly Desirable

2. Smart Environment

Responses from urban experts indicate that the perception of the smart environment in Qazvin is at an average to good level. Citizen participation in environmental protection and coverage by the urban sewage system are relatively encouraging, showcasing the community's strong environmental culture and the provincial water and sewage company's recent efforts. The SPSS analysis shows an average rating of 18.3, suggesting that while Qazvin's environmental practices are relatively desirable, there is an ongoing need for enhanced protection of natural resources (Table 6).

Table 6
Smart Environment

Item	Mean Responses	Significance Range
Level of citizen participation in environmental protection	3.26	Fairly Desirable
Percentage of the population covered by the urban sewage system	3.71	Fairly Desirable
Status of the city regarding optimal use of renewable energy	2.94	Desirable
Efficient energy consumption using new technologies in personal homes	3.18	Fairly Desirable
Intelligent protection of natural and sensitive environmental resources	2.82	Desirable
Overall Average	3.18	Fairly Desirable

3. Smart Living

Survey results indicate that the quality of health services and hospitals in Qazvin is acceptable; however, a lack of citizen involvement in planning by city officials leads to a low willingness to support city council decisions. Overall, smart living conditions in Qazvin are deemed relatively acceptable but require more proactive engagement from authorities to encourage citizen participation in city programs (Table 7).

Table 7
Smart Living

Item	Mean Responses	Significance Range
Security in both virtual and real environments for citizens	3.13	Fairly Desirable
Quality of the health system in the city	3.36	Fairly Desirable
Smart tourism facilities (such as ticket purchasing) and awareness of tourist attractions	3.18	Fairly Desirable
Intelligent and online management of the quality of the education system	3.28	Desirable
Willingness of citizens to follow city council resolutions	2.62	Fairly Desirable
Status of hospitals in terms of smart capabilities	3.26	Desirable
Status of government offices and organizations regarding connectivity to the smart network	3.09	Fairly Desirable
Overall Average	3.13	Fairly Desirable

The quantitative findings presented offer a diagnostic snapshot of Qazvin's position across the six smart city dimensions. Interpreting these results requires moving beyond the numerical scores to consider their implications for urban governance and planning. The relative strength in Smart People (high literacy, cultural engagement) and Smart Economy (emerging e-commerce, tech use in business) suggests a receptive population and entrepreneurial base – crucial social capital for smart city initiatives. Conversely, the challenges identified in Smart Mobility (access to ICT like Wi-Fi) and Smart Governance (citizen participation mechanisms) highlight critical infrastructural and institutional bottlenecks. These bottlenecks represent not merely statistical deficits but

fundamental barriers that, if unaddressed, will constrain the effective implementation of any future architectural or technological smart solutions. For instance, the limited public Wi-Fi access (Smart Mobility) directly impedes citizen engagement platforms and real-time service applications, while weak participatory mechanisms (Smart Governance) undermine the co-creation essential for sustainable urban interventions. Therefore, prioritizing investments in digital infrastructure and reforming governance models to foster inclusion are not just desirable outcomes from this survey, but prerequisites for translating Qazvin's smart city potential into tangible urban improvements.

4. Smart Mobility

Responses to questions about smart mobility were generally positive, with an average rating of 2.89 indicating a favorable level of dynamism within Qazvin. However, there is limited satisfaction regarding access to smart information and communication technologies, such as public Wi-Fi. Therefore, enhancing the transportation system, improving online services, and providing internet access in public areas are necessary steps for city officials and planners in their pursuit of a smart city (Table 8).

Table 8
Smart Mobility

Item	Mean Responses	Significance Range
Status of smart traffic signals	3.55	Fairly Desirable
Level of use of non-motorized and safe vehicles or green transportation	2.86	Desirable
Encouragement from city managers to avoid personal vehicles in favor of walking	2.66	Fairly Desirable
Access to smart information and communication technologies, such as Wi-Fi,	2.43	Fairly Desirable
Ability to control traffic for relevant organizations through smart urban systems	2.93	Fairly Desirable
Overall Average	2.89	Desirable

5. Smart Government

The governance index for Qazvin, with an average score of 3.01, indicates a relatively favorable state of smart governance. The analysis of survey responses suggests that citizens perceive the levels of smart government services and the effectiveness of combating corruption and crime as relatively good. Moreover, there is a notable use of information technology and online management in areas such as electronic banking, bill payments, and money transfers (Table 9).

Table 9
Smart Government

Item	Mean Responses	Significance Range
Level of smart urban services in the city of Qazvin	2.92	Desirable
Possibility for citizens to participate electronically and online in government decision-making	2.26	Fairly Desirable
Citizen satisfaction with efforts against corruption and crime	2.88	Fairly Desirable
Level of online financial and administrative services available in the city	3.12	Fairly Desirable
Status of electronic banking (bill payments, money transfers) in the city of Qazvin	3.88	Fairly Desirable
Overall Average	3.01	Desirable

6. Smart Economy

As shown in Table 10, the effectiveness of advertising networks and channels in cyberspace for product offerings in Qazvin is rated positively by experts. However, there is a need for greater focus from city officials and managers on enhancing online safety, as improving digital security will contribute to a stronger smart economy in Qazvin province.

Table 10
Smart Economy

Item	Mean Responses	Significance Range
Level of citizens' access to job and employment opportunities through information and communication technology	3.13	Desirable
Level of use of electronic tools for shopping	3.45	Fairly Desirable
Status of product offerings by vendors and merchants through virtual and smart platforms	3.43	Fairly Desirable
Public reception of online shopping in virtual spaces	3.63	Fairly Desirable
Impact of advertising networks and channels in virtual spaces on product sales and distribution	3.79	Fairly Desirable
Overall Average	3.49	Desirable

Based on the results of the questionnaire data analysis and disregarding average options among the responses, this paper concludes that the city of Qazvin is at an average level regarding the utilization of the six selected components of a smart city. It is clear that, with the growth and expansion of technology, the use of the internet, computers, and service applications in cities has become prevalent and is at a relatively desirable level, enjoying citizen acceptance. However, overall, the use of information technology in broader applications, such as electronic voting, electronic policing, and facilities aimed at reducing environmental pollution, remains weaker. Smart cities leverage information and communication technologies (ICT) to enhance urban living and sustainability (24). These cities employ Internet of Things (IoT) devices and sensors to improve infrastructure and services (24). While smart city applications can increase citizens' quality of life (25), awareness and adoption of these technologies vary. In Turkey, a study found that citizens lack sufficient awareness of local e-applications, suggesting a need for better information dissemination by local governments (26). Similarly, research in Qazvin, Iran, indicated an average level of smart city component utilization, with widespread use of internet and computers but weaker adoption of broader applications like electronic voting or pollution reduction technologies (27). Successful implementation of smart city services depends on innovative design, privacy protection, and high service quality, which can lead to increased usage and improved quality of life for citizens (25).

As observed in Figure 7, the feasibility of the six indices of a smart city in Qazvin has been analyzed and compared. Among these, two indices—Smart Economy and Smart People—exhibit relatively higher feasibility. An examination of the indicators for these two indices reveals a satisfactory level of technology and information technology usage in businesses and international communications, which is essential for interaction with the international community in all major cities today. Smart cities leverage information technology to enhance efficiency, transparency, and service quality across multiple dimensions (28). Six common dimensions are frequently identified: people, government, economy, mobility, environment, and living (29). These dimensions are supported by various indicators, including the use of sensors, application integration, technological innovations like IoT and big data, and AI implementation (28). Good governance, characterized by accountability and transparency, plays a crucial role in promoting smart cities (30). Studies have shown that governance positively impacts all six smart city indicators (30). Additionally, some researchers propose eight indicator groups for assessing smart cities, adding branding and demography to the six common dimensions (31). The smart city concept aims to address urban challenges arising from population growth and rapid urbanization, with the ultimate goal of improving societal efficiency and competitiveness (31).

Qazvin demonstrates a good standing in terms of the Smart People component, indicating that its residents possess a high level of culture and skills, along with a strong level of participation. Promoting an innovative spirit among citizens through the creation of platforms for attracting new ideas and public participation in social activities, such as environmental protection associations, can enhance the city's smart profile. Smart cities leverage information and communication technologies to enhance urban living and management (17). The concept typically encompasses six main components: smart people, governance, environment, transportation, economy, and living (17, 32). Qazvin demonstrates strength in the Smart People component, indicating high cultural and skill levels among residents (27). To further enhance a city's smart profile, promoting innovation and public participation in social activities is crucial (32). However, implementing smart city initiatives faces challenges, particularly in developing countries like Iran, where fragmented urban management and multiple authorities create inconsistencies (33). To address these issues, good governance plays a vital role in improving smart city indicators and resolving challenges (33). Additionally, integrating extra components such as security and ICT infrastructure into smart city models can ensure a more comprehensive and flexible approach to urban development (17).

These findings indicate that Qazvin cannot yet be classified as a fully smart city; rather, it is a city that is still evolving and progressing. With extensive cultural promotion to encourage technology adoption among all citizens, as well as suitable planning by officials and the incorporation of information technology in various areas, including environmental issues, this smart city vision can ultimately be realized in the coming years

6. Conclusion

This study provides a structured, empirical assessment of the feasibility and current status of key smart city indicators in Qazvin, Iran, based on the perceptions of urban management experts. It reveals a city with significant potential, particularly in terms of its human capital (Smart People) and emerging digital economy (Smart Economy), but facing substantial hurdles in technological infrastructure accessibility (Smart Mobility) and participatory governance (Smart Governance).

The primary contribution lies in identifying these specific leverage points and barriers within Qazvin's context. This evidence base is crucial for informing targeted policy interventions and strategic resource allocation. Rather than prescribing architectural solutions, this research highlights the foundational enablers (e.g., ubiquitous connectivity, reformed citizen engagement processes) necessary for any subsequent smart urban initiative – whether technological, architectural, or service-oriented – to succeed sustainably in Qazvin. Ignoring these systemic constraints risks implementing isolated smart projects that fail to deliver meaningful city-wide benefits.

To advance towards its smart city vision, Qazvin's authorities should prioritize: (1) Significant investment in public digital infrastructure, particularly city-wide Wi-Fi; (2) Developing robust, transparent, and accessible platforms for meaningful citizen participation in planning and decision-making; (3) Fostering greater institutional coordination to overcome fragmented urban management.
Building upon this diagnostic assessment, future research should: (a) Employ mixed-methods (e.g., in-depth interviews, case studies) to explore the causes behind the identified challenges (e.g., why participation mechanisms are weak) and develop context-specific solutions; (b) Investigate the integration potential of Qazvin's rich cultural and historical assets with smart city strategies; (c) Conduct detailed feasibility studies for specific smart infrastructure projects identified as priorities here (e.g., smart grids, integrated mobility platforms).

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