The Importance of Empowering the Smart City in Iraq: A Case Study of Baghdad Municipalities

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ABSTRACT

This research aims to analyze the factors influencing smart city enablement in Baghdad and prioritize indicators affecting this transformation while providing recommendations for improving infrastructure and smart services. The methodology relied on evaluation by a group of 120 experts specialized in architecture, urban planning, academics, municipal department directors, and municipal engineers. A structured questionnaire using a five-point Likert scale (1-5) was employed to measure experts' opinions on indicators' relevance and impact. The Likert scale was specifically chosen for its ability to quantify expert assessments and ensure consistent evaluation across multiple smart city indicators. The results showed that Karrada Municipality is ready to transform into a smart city, and digital security is the most principal factor in this transformation. The study revealed a significant disparity between municipalities in readiness for smart transformation, with general weakness in air quality and waste management. Municipalities such as Mansour and New Baghdad showed progress in digital infrastructure and smart services. The findings indicate short -, medium-, and long-term projects, and the need to launch pilot projects in Karrada, implement advanced cybersecurity solutions, and establish a Smart Municipalities Development Fund, with a focus on improving infrastructure in less developed municipalities and expanding fiber optic networks and cloud services as the last step.

1. INTRODUCTION

Cities worldwide are witnessing tremendous development thanks to rapid technological progress and the emergence of digital innovations. Smart cities have become a central part of sustainable development strategies as they provide solutions to improve the quality of life, increase the Efficiency of public services, and promote economic growth while reducing environmental impact. The potential for economic growth and a reduced ecological impact offers hope for a more sustainable and prosperous future.

In Iraq, cities face numerous economic, social, and political challenges. However, these issues highlight the opportunity for economic expansion and the advancement of sustainable development through smart city technologies. Baghdad, the capital, serves as the historical, political, and financial hub, exemplifying a significant case for examining the potentialities and challenges associated with the transition to smart cities.

This chapter provides a comprehensive theoretical framework on smart cities, reviews their importance in facing urban challenges, and highlights the global indicators that can be adopted to achieve this transformation in Baghdad.

1.1 Search problem

The challenges facing the realization of smart cities in Iraq and the Baghdad Municipalities exclusively.

1.2 Research objectives

•Analysis of the factors affecting the empowerment of smart cities in Baghdad.
•Prioritize indicators that affect the empowerment of the smart city in Baghdad.
•Provide recommendations to improve infrastructure and smart services.

1.3 Research hypotheses

• Advanced digital infrastructure, sustainable transportation, and smart services enhance the capacity of municipalities in Baghdad to transition into smart cities, while gaps in infrastructure and environmental challenges constitute the primary obstacles to this transformation.
• Supporting innovation and entrepreneurship through financial technology and business incubators plays a pivotal role in accelerating the transition to smart cities, necessitating strategic investments to strengthen the ecosystem for this advancement.

1.4 Literature review

Table 1 summarizes previous studies on smart cities and their enabling indicators.

Table 1. Literature review of the smart cities field

No.	Ref.	Empowerment Indicators
1	[1]	Smart cities in the Kingdom of Saudi Arabia have relied on taking advantage of artificial intelligence and the Internet of Things technologies to enhance the quality of life, and the most prominent examples include the development of smart electric meters, the creation of applications dedicated to serving the health sector such as the health and tamni applications, the employment of smart bracelets to serve Umrah pilgrims and pilgrims, the launch of the Najiz platform to be a unified platform for electronic justice services, and the establishment of the Madrasati educational platform to form a unified education system.
2	[2]	Analyse sustainable transport indicators and link them to urban development.
3	[3]	Dealing with the public awareness of smart solutions and their effects on different sectors.
4	[4]	The study has attempted to provide an overview of housing provision in Tehran and to assess if and how the smart city initiatives are helping to address relevant issues.
5	[5]	Focus on sustainability and link it to inclusive smart city solutions.
6	[6]	Emphasize the social and political factors in the development of smart cities.

2. THEORETICAL FRAMEWORK

2.1 Definition of smart cities

Smart cities can be defined as "an urban model that aims to integrate digital technology into urban infrastructure and services to meet the needs of the population and enhance the quality of life" [7, 8], and is a dynamic system that combines big data, cloud computing and the Internet of Things to provide more efficient and flexible services [9].

Noting that smart cities are not just the use of technology but a comprehensive framework that aims to promote sustainable development through the interaction between government, society, and the environment [10], the importance of digital planning and infrastructure should be emphasized as the main pillars for achieving smart sustainable cities.

2.2 Smart cities indicators

Smart cities enhance the efficiency of public services, such as energy and water management, reduce operating costs, and are important in addressing urban challenges such as traffic congestion, pollution, and resource shortages [11, 12].

Previous studies also emphasize that smart cities enhance government transparency and increase citizen satisfaction [13, 14]. Some [15] argue that smart cities enhance countries' competitiveness and attract international investments.

There are no specific indicators for the shift towards enabling smart cities for today's cities, so the research is directed towards reviewing the successful experiences of some countries of the world to extract indicators for enabling smart cities, including:

First: Saudi Arabia
Saudi Arabia has launched several ambitious smart city projects as part of its Vision 2030 strategy to transform urban centers into technologically advanced, sustainable communities. The most prominent among these initiatives is NEOM, a $500 billion mega-project that incorporates innovative technology and innovative urban planning, key smart city projects:

NEOM
NEOM represents a revolutionary approach to urban development, featuring: The Line - A 170km linear city without cars, streets, or carbon emissions, Advanced renewable energy systems, AI-driven infrastructure management, and Automated transportation networks.

Riyadh Smart City
The capital city's transformation includes Smart traffic management systems, Digital government services, Advanced public transportation networks, and Smart utility management.

Red Sea Project
This luxury tourism destination incorporates Smart environmental monitoring systems, Renewable energy infrastructure, Sustainable water management, and Connected visitor experiences.
These initiatives are supported by:
5G network deployment across major cities, IoT sensors and data analytics platforms, Cloud computing infrastructure, Cybersecurity frameworks, and Sustainability Focus.

Saudi Arabia's smart city projects emphasize environmental sustainability through Solar and wind power integration, Water conservation technologies, green building standards, and Waste management solutions.

These initiatives represent Saudi Arabia's commitment to creating technologically advanced, sustainable urban environments that improve quality of life while reducing environmental impact.

Second: Singapore
Singapore is one of the most advanced smart cities globally, adopting a comprehensive model for integrating technology into all areas of urban life.
The city relies on the Smart Nation plan, which aims to

improve the quality of life using technology and innovation, among the most prominent features of Singapore [16]:

Intelligent traffic management: Singapore has a sophisticated traffic management system that leverages sensors and the Internet of Things to collect real-time traffic data, ultimately alleviating congestion and improving mobility. The government provides a consolidated digital platform enabling residents to access health, education, and governmental services effortlessly.

Environmental sustainability: Singapore relies on smart water and waste management technologies like sensors to monitor water quality and control its distribution.

E-Government: Singapore provides e-government services that cover more than 95% of citizens' needs, enhancing Efficiency and transparency.

According to the report, "Singapore is a leading model in using technology to improve the lives of residents" [16].

Third: Barcelona (Barcelona, Spain)

Barcelona is a leading example of a smart city in Europe. Its smart plans respond to environmental and social needs.

Among the notable advantages of Barcelona [17]:

Smart energy management: The city relies on smart systems to monitor energy consumption in public and private buildings, contributing to reducing carbon emissions by 20%.

Sustainable transport: A public bicycle system based on digital applications has been developed to show users the optimal paths and bike locations.

Intelligent environment: Barcelona employs advanced systems to assess air quality and noise levels in residential zones, enhancing public health.

The city attempts to foster digital entrepreneurship by implementing measures that stimulate technical innovation and establish urban hubs for startups.

The EU Smart Cities Ranking [17] shows that "Barcelona has succeeded in integrating technology and the urban environment to improve the quality of life."

Fourth: Dubai (Dubai, UAE)

Dubai has emerged as a global smart city thanks to its significant investments in technological infrastructure. Among the advantages of Dubai [18]:

Smart government services: Dubai has launched the Dubai Smart Government platform, which offers hundreds of digital services such as e-payment and document management.

Smart transportation: The city provides self-driving transportation and advanced AI-based bus systems to improve efficiency and reduce emissions.

Public safety: Dubai relies on smart cameras and facial recognition technologies to enhance public security.

Urban innovation: Dubai has established the Dubai Internet City Zone to support digital innovation and attract global technology companies.

"Dubai is one of the most prominent cities that rely on artificial intelligence and the Internet of Things to manage urban life" [19].

Fifth: Tokyo, Japan

Tokyo combines advanced technology and cultural heritage to become one of the most advanced smart cities in Asia and its advantages [20], include:

Smart disaster management: Tokyo implements early warning systems for natural disasters that rely on big data analysis to minimize potential damage.

Intelligent transportation: The city uses high-speed train systems with artificial intelligence technology to ensure punctuality and efficient mobility.

Smart health services: Tokyo implements digital health services that enable citizens to schedule appointments and consult with physicians remotely, enhancing accessibility and efficiency in healthcare.

Additionally, the city promotes environmental sustainability by utilizing renewable energy systems, such as solar panels, to reduce its reliance on fossil fuels.

The Economist Intelligence Unit [20] noted that: "Tokyo represents an advanced model in the use of technology for modern development and full urban sustainability."

Sixth: London (London, UK)

London is considered one of the smartest cities in Europe thanks to its innovative use of technology to meet the needs of the population. Its characteristics [21] include:

Sustainable transport: The Oyster Card system relies on smart card technology to improve the city mobility experience.

Smart urban services: London offers apps that allow residents to monitor pollution, water, and energy consumption in homes.

Digital security: London relies on sophisticated data analytics systems to identify high-risk areas and allocate security resources efficiently.

Digital entrepreneurship: London is a global hub for startups thanks to its conducive business environment and advanced digital infrastructure.

"London is a leader in developing smart, & sustainable cities technologies" [21].

2.3 Smart cities indicators and method

By studying the existing main and sub-indicators in the six cities studied, these indicators were rearranged into main indicators and sub-indicators, as shown in Table 2.

3. DISCUSSION

The indicators listed in Table 2 were evaluated by a selected group of experts from specialized fields, including architecture, urban planning, academia, municipal department directors, and municipal engineers.

The selection of these experts was based on their extensive experience in urban development, digital transformation, and municipal governance, ensuring a well-rounded assessment of smart city empowerment indicators within Baghdad's municipalities.

To maintain methodological rigor, experts were chosen according to predefined criteria, which included a minimum of ten years of professional experience, prior involvement in smart city projects or digital infrastructure planning, and academic or professional contributions to urban development initiatives. The evaluation process was conducted using a structured survey designed to assess both the primary and secondary indicators influencing smart city readiness.

The survey employed a five-point Likert scale (ranging from 1 to 5) to gauge expert opinions on each indicator's relevance and impact. To enhance objectivity, indicator weighting was determined through a consensus-based approach, where experts assigned relative importance to different indicators. These weightings were subsequently

normalized to ensure consistency in the scoring process. The aggregated results reflect expert assessments' average rating (see Table 3).

This refined methodology improves transparency by providing a structured framework for expert selection and data collection, reinforcing the validity of the findings related to Baghdad's municipal smart city transformation.

The Likert scale (1-5) was chosen for evaluating smart city indicators in Baghdad's municipalities due to its consistency, analytical strength, and practical efficiency over alternative ranking methods:

Standardized comparability: Ensures uniform evaluation across indicators and municipalities, unlike ranking methods that lack clear intensity measures.

Captures subjective judgments: Allows experts to express gradual levels of importance rather than forcing rigid prioritization.

Enables statistical analysis: Supports mean calculations,

correlations, and regression models, unlike ordinal ranking methods requiring complex transformations.

Reduces response bias: Simplifies evaluation, minimizing cognitive burden compared to forced ranking.

Aligns with Best Practices: Widely used in urban planning and smart city research, ensuring credibility and comparability.

Allows weighting adjustments: Enables post-evaluation weighting for enhanced flexibility.

Thus, the Likert scale ensures reliability, ease of analysis, and methodological robustness, making it the suitable choice for this study.

And because we take 120 opinions of experts in different experiences & fields, all opinions are respectful, so; the authors decided to take the average of the opinions grade to prove which criterion is the most important in smart city implementation, and the order of importance is as shown in Table 4.

Table 2. Main and sub-indicators of smart cities based on the selected city model study

No.	Secondary Indicators	Indicator Symbol
1	Smart Grid Efficiency (Internet Networks and Digital Infrastructure)	A1
2	Availability of infrastructure monitoring systems	A2
3	Quality of digital services such as e-government	A3
4	Efficiency of digital health services	A4
5	Efficiency of digital educational services	A5
6	Energy Management Efficiency	B1
7	Efficient waste management	B2
8	Air quality monitoring and environmental sustainability	B3
9	Efficiency of sustainable transport systems	B4
10	Intelligent Traffic Management Effectiveness	B5
11	Provides intelligent surveillance systems for security	C1
12	Efficient security data analysis	C2
13	The role of technological incubators in supporting innovation	C3
14	Supporting startups to foster innovation	C4
15	Efficiency of digital security in the city	C5

Table 3. Analysis of the results of the detailed questionnaire for each indicator based on the results of the expert questionnaire

No.	Pointer	Average Rating (1-5)	Analysis
1	Smart Grid Efficiency (A1)	4.2	A high rating indicates the importance of smart grids in supporting smart cities.
2	Availability of infrastructure monitoring systems (A2)	3.8	This aspect is important for improving basic services such as electricity and water.
3	Quality of digital services such as e-government (A3)	4.5	There is a broad consensus on the importance of e-government in promoting transparency and accessibility.
4	Digital Health Services Efficiency (A4)	4	The need to strengthen healthcare through technology.
5	Efficiency of Digital Educational Services (A5)	3.9	Emphasis on supporting the infrastructure of distance education.
6	Energy Management Efficiency (B1)	4.3	Energy management is important for reducing consumption and achieving sustainability.
7	Efficient Waste Management (B2)	4	Smart technologies contribute to recycling and waste management.
8	Air Quality and Environmental Sustainability Monitoring (B3)	3.7	The challenges associated with air quality monitoring require addressing.
9	Efficiency of sustainable transport systems (B4)	4.4	Sustainable transport is a key factor in smart cities.
10	Efficient Intelligent Traffic Management (B5)	4.1	Smart traffic systems improve mobility and reduce congestion.
11	Availability of intelligent surveillance systems for security (C1)	4.6	Intelligent surveillance systems are essential to enhance security.
12	Security Data Analysis Efficiency (C2)	4.4	Data analysis enhances security and helps meet challenges.
13	The Role of Technology Incubators in Supporting Innovation (C3)	4.2	Technology incubators are key to supporting innovation.
14	Supporting startups to foster innovation (C4)	4	Startups contribute to the promotion of urban innovation.
15	City Digital Security Efficiency (C5)	4.5	Digital security is essential to data protection and sustainability.

Source: According to Likert analysis, the list of indicators is based on expert opinion.

Table 4. Ranking of indicators according to experts opinions average rating

Order	Pointer	Average Rating
1	Availability of intelligent surveillance systems for security (C1)	4.6
2	Quality of digital services such as e-government (A3)	4.5
3	City Digital Security Efficiency (C5)	4.5
4	Efficiency of sustainable transport systems (B4)	4.4
5	Security Data Analysis Efficiency (C2)	4.4
6	Energy Management Efficiency (B1)	4.3
7	Smart Grid Efficiency (A1)	4.2
8	The Role of Technology Incubators in Supporting Innovation (C3)	4.2
9	Efficient Intelligent Traffic Management (B5)	4.1
10	Digital Health Services Efficiency (A4)	4
11	Efficient Waste Management (B2)	4
12	Supporting startups to foster innovation (C4)	4
13	Efficiency of Digital Educational Services (A5)	3.9
14	Availability of infrastructure monitoring systems (A2)	3.8
15	Air Quality and Environmental Sustainability Monitoring (B3)	3.7

Source: Table 3

3.1 Top rated indicators

Availability of intelligent surveillance systems for security (C1): 4.6.
Quality of digital services such as e-government (A3): 4.5.
City Digital Security Efficiency (C5): 4.5.
Efficiency of sustainable transport systems (B4): 4.4.

3.2 Least rated indicators

Efficiency of digital educational services (A5): 3.9.
Availability of infrastructure monitoring systems (A2): 3.8.
Air Quality and Environmental Sustainability Monitoring (B3): 3.7.

4. CITY OF BAGHDAD AND ITS CHALLENGES

Although the study reviews the successful international smart city models mentioned in the previous paragraphs, their direct applicability to Baghdad requires a deeper analysis of the local context. Iraq's infrastructure, economic reality, and political landscape are very different from these cities, necessitating ad hoc adjustments. The following are the most important aspects that must be considered to ensure the effective implementation of smart city projects in Baghdad:

Infrastructure readiness compared to global models: Baghdad suffers from a significant infrastructure deficiency due to the obsolescence of networks, the lack of digital infrastructure, and the repercussions of previous conflicts.

Governance and institutional capacity: Cities such as London and New York rely on strong governance systems and advanced regulatory frameworks, while Baghdad faces institutional challenges, poor administrative efficiency, and policy instability, which may slow down the process of smart transformation, and it will be necessary to develop a national strategy for digital transformation with clear governance mechanisms to ensure effective implementation.

Socio-economic considerations: Unlike Tokyo or Barcelona, where smart city technologies are easily adopted due to high digital awareness, Baghdad suffers from disparities in the level of digital awareness and internet access, so comprehensive programs to spread digital literacy and build capacity should be implemented before proceeding with large-scale smart city projects.

Security and political stability: While Dubai and Singapore rely on advanced surveillance technologies to enhance public security, the security challenges in Baghdad call for a dedicated approach that balances the use of smart technologies to maintain security with respect for civil liberties and the protection of personal data.

Financial and investment constraints: Cities such as New York and London have the potential to attract huge private sector investment, while Baghdad relies heavily on limited government funding, and emphasis should be placed on public-private partnerships (PPPs) and enhanced international cooperation to ensure sustainable financing for smart transformation projects.

Environmental challenges and sustainability: The problem of air pollution and waste management is one of the biggest challenges facing Baghdad, compared to advanced sustainability initiatives, and smart low-cost systems for air quality monitoring and waste management can be implemented digitally as a viable first step.

Although global smart city models offer valuable insights, Baghdad needs a step-by-step and ad hoc approach that considers its urban realities, administrative capabilities, security challenges, and financial resources. An adaptive strategy based on local priorities will be more effective in achieving a smart, sustainable and inclusive transformation of the city.

According to Table 4, the list was then presented to a sample of experts to determine the priority of implementing empowerment indicators across the 18 municipalities of Baghdad City (Table 5).

5. RESULTS

The expert questionnaire revealed the following results (Table 6, Figure 1).

5.1 Air quality and waste management

Air quality and waste management are ranked among the least evaluated factors in Baghdad's readiness for smart transformation, so it is necessary to provide specific technical solutions to enhance environmental sustainability.

Table 5. Indicators presented to experts and the possibility of their application in the municipalities of Baghdad

No.	Municipality Name	Digital Infrastructure and Smart Services Index					Environmental Sustainability and Sustainable Mobility Index					Digital Security and Innovation Index				
		A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
1	Karkh Mun.															
2	Rusafa Mun.															
3	Kadhimiya Municipality															
…	.....	....														
18	New Baghdad Municipality															

Table 6. Results of the questionnaire to enable the smart city in the municipalities of Baghdad

Order	Municipality Name	Total	Average	Highlights	Analysis
1	Karrada	78	4.8	• Smart grid efficiency: 5 • Quality of digital services: 5 • Energy management efficiency: 5 • Smart traffic management efficiency: 5 • Digital security: 5	A municipality with high potential for transformation into a smart city, thanks to its superiority in digital indicators and infrastructure.
2	Al, Mansour	76	4.5	• Quality of digital services: 5 • Efficiency of sustainable transport systems: 5 • Digital security efficiency: 5	A municipality with useful resources and balanced indicators in infrastructure and digital security.
3	New Baghdad	74	4.4	• Energy Management: 5 • Digital Security: 5 • Efficiency of digital educational services: 5 • Efficiency of sustainable transport systems: 5	Its remarkable digital security and education superiority make it a strong candidate.
4	Aldora	72	4.3	• Waste management efficiency: 5 • Quality of digital services: 5	has a durable foundation in resource management and e-government services.
5	Husseiniya	70	4.2	• Energy management efficiency: 4 • Digital security: 5	Balanced performance in most indicators with a need to promote sustainable transport.
6	Rusafa	68	4.1	• Efficiency of smart grids: 4 • Efficiency of sustainable transport systems: 4	A municipality with good potential but needs to improve its digital infrastructure.
7	Alsha'b	66	4	• Traffic management effectiveness: 4 • Digital Security: 4	need to support innovation and improve sustainable transport.
8	Kadhimiya	65	3.9	• Quality of digital services: 4 • Waste Management: 4	need to strengthen energy management and transportation systems.
9	Za'franiya	64	3.8	• Energy management efficiency: 4 • Digital security: 5	A municipality with good potential in digital security with a need to develop infrastructure.
10	Shu'la	62	3.7	• Efficient waste management: 4 • Effective traffic management: 4	Additional support is required for digital infrastructure and transportation.
11	ALGhadeer	61	3.6	• Digital Security: 5	It has strong capabilities in digital security, but the rest of the indicators need to be developed.
12	Aljazeera	60	3.5	• Quality of digital services: 5	Moderate potential needs improvement in sustainable transport and energy.
13	Adhamiya	59	3.4	• Efficient waste management: 4	need a thorough improvement in digital indicators and transport.
14	Nahrawan	58	3.3	• Energy management efficiency: 4	Performance is average, and there is an urgent need to support innovation and digital transformation.
15	Alsader 1st.	56	3.2	• Traffic management effectiveness: 4	need to improve digital security and infrastructure.
16	Alsader 2nd.	54	3.1	• Energy management efficiency: 4	Digital security and digital services need to be strengthened.
17	Almadaen	53	3	• Sustainable transport efficiency: 4	need comprehensive support on all indicators.
18	Karkh	52	2.9	• Smart grid efficiency: 3	The least potential and requires a comprehensive development plan.

Source: Researchers based on the results of the questionnaire.
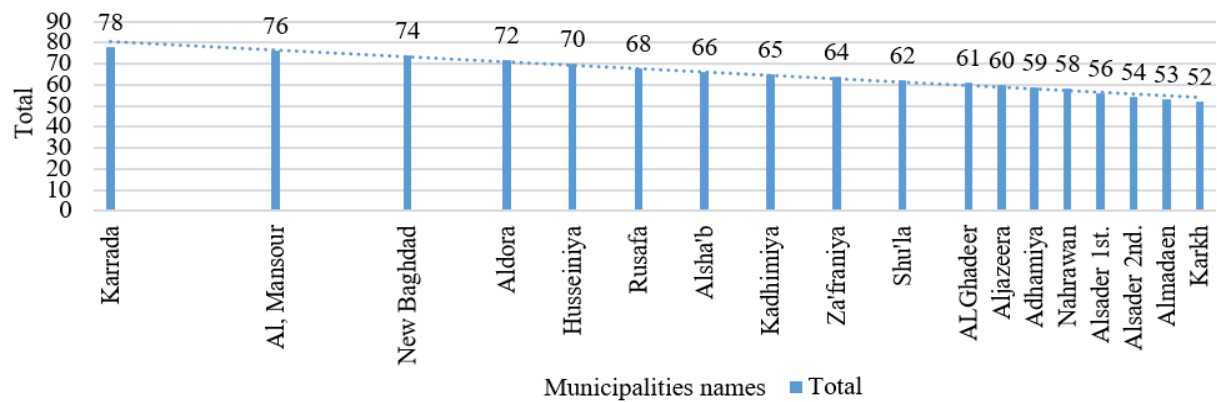
Figure 1. Municipalities of Baghdad ranking to enable the smart city
Source: Results taken from Table 5.

5.1.1 Smart air quality monitoring solutions

Due to the increasing pollution due to industrial and vehicle emissions, smart monitoring systems can be adopted that include:

IoT sensors measure air pollutants such as PM2.5, NO_2, CO_2 and transmit data to digital platforms for real-time analysis.

AI analytics to predict areas of high pollution and take measures such as traffic control or the creation of green zones.

Awareness applications to inform citizens of pollution levels and preventive health guidelines.

5.1.2 Smart waste management technologies

To improve waste collection efficiency and reduce pollution, the following can be implemented:

Smart containers with sensors that send full data to improve collection scheduling and reduce fuel consumption.

Data analysis and artificial intelligence to plan the best routes for waste trucks and increase the efficiency of operations.

Automated sorting stations that use robots and artificial intelligence to separate recyclables.

Waste-to-energy through biodegradation or safe incineration projects to support energy sustainability.

Interactive applications that allow citizens to report environmental violations and encourage recycling through incentives.

5.2 Key digital security challenges in Baghdad

• Increased cyberattacks: Increased hacking attempts due to the increasing reliance on digital services.

• Weak technological infrastructure: Lack of protection in some sensitive digital systems.

• Lack of strong digital legislation: the need for strict data protection and privacy policies.

• Low cybersecurity awareness: Lack of training in some organizations and users on digital protection methods.

• Poor coordination between government and private entities: the need for unified cybersecurity strategies.

5.3 Proposed opportunities and solutions to enhance digital security

• Develop a strong cyber infrastructure using modern data and network protection systems.

• Use artificial intelligence techniques in cybersecurity to monitor and analyze digital threats in real time.

• Strengthen digital legislation and laws to impose strict

standards on cybersecurity.

• Launch awareness and training campaigns to raise the level of security culture among individuals and institutions.

• Enhance cooperation between the government and the private sector to establish a national cybersecurity center to effectively counter digital attacks.

6. CONCLUSIONS

1) Karrada Municipality is the readiest to transform into a smart city, as it scored high ratings in all the studied indicators, making it a suitable model for pilot smart city projects.

2) Digital security is the most important factor in the transition to smart cities, as it received the highest ratings in many municipalities, highlighting its role in enhancing trust in digital services.

3) There is a significant disparity between municipalities in preparing for smart transformation, as this gap reflects the differences in infrastructure and digital capabilities of each municipality.

4) Most municipalities suffer from poor air quality and waste management, highlighting environmental challenges that need sustainable solutions to promote smart transformation.

5) Municipalities such as Mansour and New Baghdad have made remarkable progress in digital infrastructure and smart services, suggesting that they can be developed as major technology hubs.

6) Supporting startups and technology incubators is essential to accelerate innovation, as innovation is a key element in the development of smart cities.

7) Efficient energy management is a key indicator in developed municipalities, reinforcing the importance of investing in smart energy systems to achieve digital transformation.

8) Municipalities such as al-Karkh and al-Madaen have shown general weakness in all indicators, requiring focused efforts to improve their infrastructure and smart services.

9) Municipalities that feature digital education and smart health services receive higher positive ratings, reflecting the importance of developing these sectors in promoting smart transformation.

Municipalities that have developed sustainable transport systems have shown greater willingness to shift to smart cities, highlighting the importance of investments in smart and sustainable transport systems.

7. RECOMMENDATIONS

1) Launching pilot projects for smart cities in Karrada, including smart traffic systems, digital government, and environmental monitoring based on the Internet of Things as short term projects.

2) Implement advanced cybersecurity solutions, such as artificial intelligence and blockchain technologies, to ensure data protection and enhance trust in digital services as medium term Projects.

3) Establish the Smart Municipalities Development Fund, to allocate resources according to digital readiness levels, with a focus on improving infrastructure in less developed municipalities as fast initatives.

4) Deploy intelligent air quality monitoring systems and smart waste containers with sensors, to improve pollution control and waste management efficiency as short term initative.

5) Expanding fiber optic networks and cloud services in advanced municipalities such as Mansour and New Baghdad, to support sustainable digital transformation.

6) Establish technology incubators within municipalities, providing financial incentives and regulatory support to encourage innovation in artificial intelligence, fintech and the Internet of Things for all municpalities with Baghdad governate Supervision.

7) Invest in smart energy systems, such as smart grids and data analysis to improve energy distribution, and promote the use of renewable energy for long term investment.

8) Implementing infrastructure development programs in less developed municipalities (such as Karkh and Madaen), through smart traffic systems, digital services, and smart water networks as first step in these mucipalities.

9) Expanding digital education and smart health services through e-learning and distance medicine platforms, to ensure citizens' access to modern services in all municipalites according to sequancial plan.

Develop sustainable transport through the establishment of charging stations for electric vehicles, smart traffic systems, and public transport networks powered by artificial intelligence, to reduce congestion and reduce carbon emissions, as long term projects in all municipalities to build Smart Cities.

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