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# SMART CITIES BENEFITS AND CHALLENGES IN CONSTRUCTION PROJECTS

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**Abstract**

Over the past ten years, smart city research and application have grown in popularity. A thorough analysis of the literature evaluations that have already been published on SCs reveals a dearth of studies that categorize the literature into different themes and determine which topics are more and less popular based on the quantity of peer-reviewed research articles that fall under each subject. Therefore, the primary goal of this study is to determine the key advantages and difficulties of smart cities as well as the most productive phase of building projects.
The results show that while topics like the social impact, governance and policy, performance indicators and standards, and citizens' involvement in the design and development of SCs have received moderate attention, themes like innovation and technology, SC services design and management, and citizens' involvement have been thoroughly researched. Less well-liked topics include the SC approach and implementation obstacles, nevertheless.

**Keywords:**

Smart;
Cities;
Benefits;
Challenges;
Indexes.

## 1 Introduction

The engineering and construction (E&C) sector is about to enter a new age as a result of technological entrepreneurs developing new tools and apps that are altering how businesses plan, organize, and carry out projects. Many of the issues that have plagued the E&C sector for decades are being resolved by these creative start-ups by offering cutting-edge software, hardware with an emphasis on building, and analytics capabilities. One such issue is the inability to gather and distribute project information. The timing of these advances could not be better, as managers are under more pressure to reduce costs, increase timeliness, and boost efficiency as building projects get more intricate and costly.[1]

Product innovation in the construction sector is being driven by the need for economic growth and technological improvement. The industry's lack of procedures to successfully integrate innovative goods, however, is a cause for worry. Two constructs were established for increasing implementation rates, and recent research have produced a strategy for recognizing and analyzing the risks that effect the adoption of new technology. [2]

A multi-industry and multi-department (MI & MD) smart corporate information management system is required to accomplish the efficient integration and usage of information resources. [3] The goal of the 1990s Smart City idea was to integrate cutting-edge information and communication technology (ICT) into urban planning [4]. The notion of Smart City is associated with a number of other ideas, including intelligence, ubiquity, knowledge, information, and digital city, according to the demands of decision-makers and the evolution of the concept [5]. By integrating ICT technology, smart cities seek to increase the efficacy, efficiency, accountability, and transparency of interactions between the public and the government [5].

A approach commonly employed in social science research, text analysis tagging techniques have been used to study the definitions of Smart Cities. The identified major concerns have guided the separation and analysis of the definitions' essential terms. Based on the given literature, the definitions have been categorized and classified in accordance with how well they match with the concerns. [6].All of the components, limits, scope, and terminology should be taken into account while defining a comprehensive smart city idea.

A smart city is composed of land, people, technology, and governance. Its boundaries can be more or less defined, ranging from the local urban dimension of a single city to a region, a network of cities, and eventually the national and global dimension. It should have clearly defined and quantifiable objectives with regard to these aspects: environmental sustainability, the development of intelligent intellectual capital, public participation, and well-being. It is now feasible to attempt to compose the following detailed definition of a smart city"A well-defined geographic region is a smart city, where advanced technologies such as information and communication technology (ICT), logistics, energy production, and so on) collaborate to improve citizens' quality of life, inclusion and participation, environmental quality, and intelligent development; it is overseen by a clearly defined group of people who can set the rules and policies for city government and development. [7] Reputable commercial associations and governmental organizations provide the following definitions of a smart city:
Association of Southeast Asian Nations [8]: "To address urban challenges, enhance people's lives, and generate new opportunities, an ASEAN smart city employs technical and digital solutions as well as innovative non-technological ways. A "smart sustainable city," which fosters social and economic growth as well as environmental preservation through efficient mechanisms that handle current and future concerns confronting the population without excluding anybody, is similar to a "smart city." Smart city development should be designed in accordance with a city's inherent potential and characteristics, since this remains an important component of a city's economic growth and competitive advantage.

- The British Standard Institution defines a smart city as one that integrates physical, digital, and human systems to provide a sustainable, wealthy, and inclusive future for its residents [9].• European Commission[10]: "A smart city is a location where traditional networks and services are enhanced for the benefit of its residents and businesses by utilizing digital and telecommunication technologies."
- A smart city uses ICT in more ways than only reducing emissions and optimizing resource usage. It entails improved waste management and water supply systems, more intelligent urban transportation networks, and more effective methods of heating and lighting buildings. It also entails satisfying the requirements of an aging population, safer public areas, and a more involved and responsive local management.
- "Embrace innovation and technology to build a world-famous Smart Hong Kong characterised by a strong economy and high quality of living," says the Innovation and Technology Bureau, Hong Kong [11].
- The Electronics and Electrical Institute Community of Smart Cities [12]: In order to accomplish at least some of the following, a smart city brings together society, technology, and government: smart mobility, smart economy, smart environment, smart cities, smart governance, smart people, and smart living.

International criteria for sustainable development consider the demands of the present on the environment, society, and economy without compromising the chances that future generations will have access to resources. The development of Smart City standards is being undertaken by several national and international standards groups. Nevertheless, it is unlikely that certain standards will address the difficulty of managing the smart city system. Working together, many municipal stakeholders and standards organizations can produce a broad model of the city and its processes. In order to ensure that the city's demands for managing issues like privacy, security, resilience, data flow, and so forth are satisfied in a networked system, including the assessment of the use of ICT in achieving a smart city. To understand the myriad complexity and interrelated ICT concerns associated with the move to smarter cities, interoperability across diverse municipal systems is required. in order to show more sensible progress in meeting the city's requirements. Specifically, relevant standards begin to become quantified [11] . The International Organization for Standardization, or ISO, established a technical committee named ISO to address sustainable cities and communities. This technical committee controls sustainable city and community standards to assist all cities and communities, as well as their stakeholders in both rural and urban regions, in becoming more sustainable. This comprises defining standards, policies, guidelines, and supporting methodologies and instruments relevant to attaining sustainable development while taking intelligence and resilience into consideration.: [13]

1- TC 268's standardization efforts support the UN Sustainable Development Goals by promoting the creation and implementation of an all-encompassing, integrated approach to sustainability and sustainable development.

2- A set of indicators to guide and gauge the quality of life and service performance of smart cities are defined and established by the smart city standard. Regardless of size or location, it adheres to the standard's guiding principles and aims to assess its performance in a comparable and verifiable manner. It also describes tasks related to information and communication technology (ICT), energy,

water, transportation, trash, and other aspects of smart community infrastructure. In light of sustainable development and community resilience, intelligence is understood to be performance related to technologically implementable solutions. All societal levels can be included and one or more categories of community infrastructure can be covered by smart city standards.

3- One of the key benefits of the smart city idea for waste management is that the pandemic has accelerated the use of smart cities as managing medical waste is necessary to combat Covid-19[21].

The following are the requirements that the technical committee and subcommittee for city and community sustainability have created for smart cities:[21]

4- The standards and usage guidelines for the ISO 37101 Sustainable Development in Communities Management System

5- Indicators for city services and quality of life in ISO 37120 Sustainable cities and communities,

6- Indicators for smart cities: ISO 37122 Sustainable cities and communities 4) ISO/TR 37150 Intelligent community infrastructures: examination of ongoing initiatives pertinent to the metric

Although there are several smart city indices now in use, they vary in terms of their coverage area, topics, and degree of measurement [13,14] Indexes can be further categorized into certain groupings based on their primary foci using a typology[14]. Despite this, we agree that systematic reviews—especially the search strategy—are ensured by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist [15].

The smart city indicators displayed in table (1) The first column indicate the author and the second indicate the main indexes that used in the smart cities and the last one the sub-indexes that used.

Table 1: Smart City Indictors

| Author | Index main | Sub index |
|---|---|---|
| [16] | environmental index<br>economic index<br>social index<br>population index | Greening<br>The water in the urban sewer<br>Waste<br>Economic aggregate<br>Industrial structure<br>Traffic<br>Consumption<br>population scale |
| [17] | Economy<br>Human Resources<br>Environment<br>Innovation<br>Citizens (people) | Information Technology Education, Information Technology Infrastructure, Information Technology Economy |
| [18] | Economy<br>Human Resources<br>Governance<br>Mobility<br>Environmental<br>Living | dedication to doing climate action. Rate of renewable energy<br>Rate of waste recycling<br>CO2 emissions for each individual<br>A popular tourist destination. closeness to a World Heritage Site. possibilities for nightlife. The quantity of theaters. quantity of museums. The quantity of stadiums.<br>The quantity of hotel rooms<br>The quantity of opulent hotel rooms |
| [19] | environmental index<br>economic index<br>social index<br>culture and life style | GDP nominal GDP per person<br>GDP Rate of Growth<br>Financial Independence Capitalization of the stock market<br>total work workers in the business support services industry. Pay scale<br>The accessibility of knowledgeable human resources. a range of job environments<br>Rate of corporate taxation<br>Risk in business, politics, and economy |

The main aim of the paper is determine the most benefit and challenges of developing smart cities and to determine the most important factors in each stage of construction projects for the smart cities.

## 2 Methodology

To ascertain the purpose of the paper, a questionnaire undergoing statistical analysis was developed with input from engineers involved in construction sector projects. The objective was to ascertain the smart city indexes, the techniques employed in evaluating these cities, and the benefits and drawbacks of utilizing these cities. Figure (1) presents the paper tasks, data collecting techniques, and analytic outcomes in an easy-to-view format.

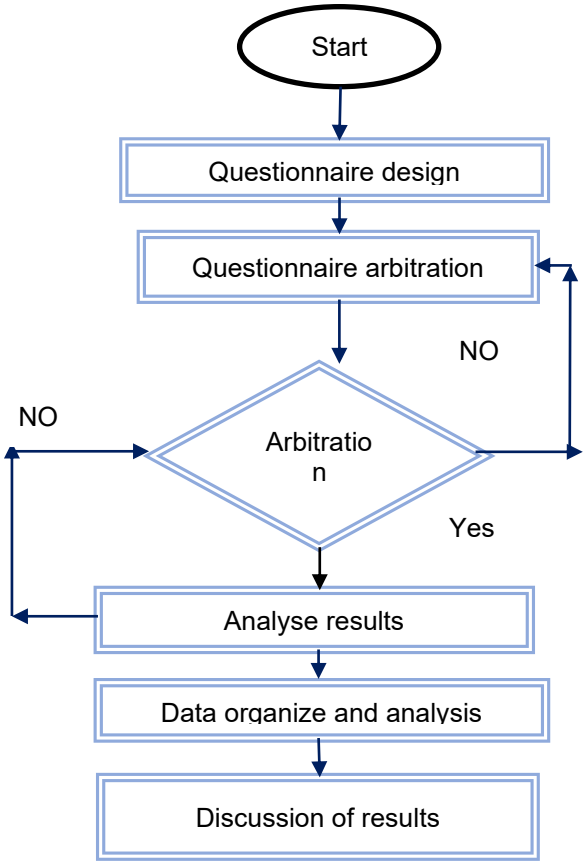


Fig.1 Flowchart of practical study

In order to determine if a full-scale study should be conducted for this research, a field study will be conducted , the . Forty engineers were chosen based on their high level of experience and technical expertise in project execution to assess the preliminary questionnaire .After completing the design of the questionnaire's form and information, the questionnaire directed to the public sector (Project management department/ Ministry of construction and housing,) and private sector engineers and in various specializations and those with sufficient experience in this field. 40 questionnaires list were distributed as follow: 1) Distributing the questionnaire directly to the participants after providing an explanation with examples by the researcher. This method is considered ideal through direct follow-up and answers through these direct meetings. From 30 questionnaire list, 20 correct were obtained. 2) The questionnaire was distributed to the participants electronically, where 40 forms were distributed with an explanation and an introduction about the purpose of the questionnaire with an attached audio recording. 25 correct forms were collected, A complete and correct 45 questionnaire forms were collected from the total participates in Baghdad , Iraq.

Participants in a survey meant to evaluate their preferences or the relative importance of various factors may be asked to rate the extent to which they have learned about various topics on an ordinal scale . The Likert Scale had an ascending order to make sure that participants carefully considered all their options before making an accurate rating. Each question's response is one of five possible answers, and this is the foundation of the questionnaire's design. The Likert Scale Quintet is employed as a result. Typically, values are entered as shown in tables (2).

Table 2: Likert Scale

| Scale | Degree of effect |
|---|---|
| 5 | Very high |
| 4 | High |
| 2 | Medium |
| 3 | Low |
| 1 | Very low |

. Academic certificates show that 53% of students hold a bachelor's degree, 35% a master's, 9% a doctorate, and 3% a diploma. With regards to the respondents' years of experience, 50% of them represent 10–19 years, 22% represent 20–29 years, 22% represent 1–9 years, 3% represent 30–40 years, and 3% represent more than 40 years. Of those with a specialty, 47% are civil, 20% are electrical, 15% are mechanical, and 18% are other.

The purpose of the questionnaire is to illustrate smart city indices, advantages, and disadvantages. After speaking with experts and professionals, the researcher created a closed questionnaire in order to accomplish this purpose. Based on the data from the research's theoretical analysis, a questionnaire form was created. All responders will find it easy to complete the questionnaire because of its straightforward design. After the preparation was finished, the questionnaire was given to the sample. A variety of relevant fields with both scientific and practical expertise made up the research sample. In order to make the questionnaire accessible to as many experts as possible, an electronic version was chosen.

The cover page of the questionnaire includes the title of the study and its main goals. The term "smart city" in relation to building projects is defined, and recommendations are made regarding responder anonymity. This may encourage a high response rate and improve respondents' viewpoint while responding to interview questions.

Any statistical analysis performed on survey or questionnaire data is based on them. The following sections are included in this section:
Part I: This section contains the personal data (academic certificate, years of experience, employment sector, and specialization) of the sample for which the questionnaire was created. This data is crucial for determining the significance of the responses.
Section II: This section contains the city's smart city assessment and a broad overview of smart cities.
Part III: The advantages and difficulties of smart cities are covered in this section. Each responder is allowed to provide responses depending on how they view the construction projects thanks to the questions in this section.
Part IV: The whole list of smart city indices is contained in these four parts.

## 3. Results and Discussion

In order to determine the outcomes of this work, the questionnaire's items' RII, mean, and standard deviation were extracted. The widely used mean score ranking approach was used to rank the elements [22]. Using the following formula, the average score of the respondents' evaluations for each component is derived using this method:

$$\text{Mean} = \sum_{i-1}^{n} Xi \quad (1)$$

Where n = no of respondents

Standard deviation (SD) is one of the most significant measures of Variability. It is a quantitative mean that measures variances between values in a distribution and indicates the extent to which data is cantered or dispersed [23] . The calculation of the standard deviation (S) for respondents to each criterion is based on the following equation [24]:

$$S = \sqrt{\sum_{k=0}^{n}((xi - x)^2) * fi(\sum_{k=0}^{n} fi)} \quad (2)$$

Where
S = standard deviation
$xi$ = mean score

$x$ = degree of the criterion importance
fi= frequency

One technique for data analysis is the relative important index (RII), which assigns a rank to each item in each section of the questionnaire. There is a widespread interpretation of significance, which is related to preferences, dominance, and similar interactions. The variables are defined in the questionnaire to guarantee uniformity throughout the sampling process. The surveys are designed in a way that helps maintain the consistency and dependability of the data. It is necessary to quickly examine the goal and methodology that are provided in a manner that is meant to speak directly to each respondent if high-quality data is to be obtained.

The replies, in particular, stressed how important it is to guarantee consistency when drawing comparisons. The participants were directed to acknowledge that their answers must not be skewed towards endorsing any program, regardless of its extraordinary success or catastrophic failure [25]. The following equations were used:

$$\mathrm{RII} = \frac{\sum \mathrm{W}}{(\mathrm{A}*\mathrm{N})} \quad (3)$$

Where:

W: The weight given by respondents for each component (ranging from 1 to 5) A: Represents the highest weight (which equals 5)
N: Represents the total number of respondents
Based on Equations from (1) to (3) , The relative importance and the mean for the main factors that consider the familiar traditional building, as shown in the Table (3).

Table 3: Traditional Building Familiar

| S | Items | Mean | Std. Deviation | RII |
|---|---|---|---|---|
| T1 | Meets safety and sustainability requirements | 3.1176 | 1.00799 | 62.35 |
| T2 | renewable energy | 2.5588 | 1.30712 | 51.17 |
| T3 | there has been used the correct building standard | 3.4412 | 1.07847 | 68.82 |
| T4 | The buildings are evaluated and maintained on an ongoing basis | 2.9706 | 1.05845 | 59.41 |

The results show that the traditional buildings doesn't meet the standard in the process of construction and with absence of the renewable energy , that lead to dissatisfaction of the traditional and must to move toward new technology. The following part represents the challenges and benefits of development of smart cities

Table 4: Benefits of Smart Cities

| NO | Items | Mean | Std. Deviation | RII |
|---|---|---|---|---|
| 1 | Reduce project cost through project automation | 3.79 | .76 | 59.41 |
| 2 | Management is effective through independent organization | 3.88 | .76 | 83.52 |
| 3 | It meets the requirements of energy saving and environmental friendly | 3.97 | .96 | 75.88 |
| 4 | More economical by using recycled materials | 3.79 | .76 | 79.41 |
| 5 | Improving urban transportation and public transportation | 4.05 | .81 | 79.41 |
| 6 | Make Better Decisions: Data-driven decision making can improve the efficiency and effectiveness of city services and the decision-making process. | 4.11 | .53 | 75.88 |
| 7 | Improved safety and security: Smart city technology can improve public safety and security through enhanced surveillance, emergency response systems, and crime prevention. | 4.359 | .59 | 81.17 |
| 8 | the efficiency and effectiveness of city services and the decision-making process. | 4.17 | .90 | 87.05 |

| | | | | |
|---|---|---|---|---|
| 9 | Improved safety and security: Smart city technology can improve public safety and security through enhanced surveillance, emergency response systems, and crime prevention. | 4.26 | .66 | 84.11 |
| 10 | Low carbon emissions | 4.17 | .62 | 85.29 |
| 11 | Increased economic development: Smart cities can attract new businesses and investments, boosting local economies. | 3.91 | .66 | 83.52 |
| 12 | Implementing smart city technology is expensive and may require significant investments in infrastructure and technology. | 4.17 | .62 | 78.23 |

'The efficiency and effectiveness of city services and the decision-making process' is the highest rating, with almost 87%, according to Table (4). Although evidence-based decision-making is marketed as being efficient and successful, obstacles to its adoption have included a lackluster supportive culture, restricted access to evidence, and incompletely applicable evidence. Concepts of smart cities include evidence-based policy decision-making, economic and environmental sustainability, and improved quality of life. We questioned whether evidence-based decision-making expertise had progressed as a result of smart city theory and practice [26].As the difficulties in creating intelligent cities are shown in table (5)

Table 5: Challenges of Smart Cites

| NO | Items | Mean | Std. Deviation | RII |
|---|---|---|---|---|
| 1 | Implementing smart city technology is expensive and may require significant investments in infrastructure and technology. | 4.17 | .62 | 83.52 |
| 2 | Integration of various systems and devices, careful planning and coordination. | 3.98 | .66 | 78.23 |
| 3 | Privacy and security in data collection, storage, and use in smart cities. | 4.05 | .73 | 81.17 |
| 4 | Ensuring that different systems and devices can work together effectively is a challenge. | 3.88 | .72 | 77.64 |
| 5 | Lack of standardization across different systems and devices | 3.79 | .84 | 75.88 |
| 6 | The workforce is skilled | 3.76 | .95 | 75.29 |
| 7 | Strict laws are non-negotiable in the implementation of smart cities | 3.94 | .95 | 78.82 |
| 8 | Complete reliance on the Internet in implementing smart cities | 4.11 | .87 | 82.35 |

Table (4) demonstrates that the top ranking statement is "Implementing smart city technology is expensive and may require significant investments in infrastructure and technology." Smart city projects are now routine tactics employed by local governments to enhance management efficiency, deliver better services, and boost public involvement in civic decision-making. The use of data, information, and communication technology (ICT) to enhance municipal operations has enormous promise. However, many smart city programs may be viewed as expenditures that are excessively costly and difficult to sustain over time, depending on the size and financial standing of the cities. To reap the majority of the benefits that come with the extensive use of technology and data, municipal administrations should focus on developing financially sustainable smart cities.[27]
This part represents the most indexes that used in smart cities as the first part represent the important stage in evaluating smart cities in the project?

Table 6: Important Stage in Evaluating Smart Cities

| Stage | Mean | Std. Deviation | RII |
|---|---|---|---|
| planning | 4.61 | .65 | 92.35 |
| design | 4.55 | .56 | 91.17 |
| construction | 4.38 | .65 | 87.64 |
| control and monitoring | 4.38 | .65 | 87.64 |

Table (6) represent that planning is the most important stage in evaluating the smart cities.
The second part represent the factors in each stage that can be used to build smart cities.

Table (7) Smart Cities Factors in Planning

| Factors | Items | Mean | Std. Deviation | RII |
|---|---|---|---|---|
| Economic | 1. The cost of preparing a business plan | 3.97 | .62 | 79.41 |
| | 2. Innovation in the project idea | 4.05 | .77 | 81.17 |
| | 3. There is sufficient funding for the work team | 4.00 | .98 | 80 |
| | 4. Flexibility in preparing plans | 3.82 | .83 | 76.47 |
| | 5. Policies, programs and plans to promote entrepreneurship | 3.67 | .84 | 73.52 |
| | 6. Market value of securities | 3.5000 | 1.08012 | 70 |
| | 7. Availability of skilled human resources | 4.0588 | .91920 | 98.82353 |
| | 8. A variety of workplace options | 3.76 | .85 | 75.29 |
| Social | 1. Traffic for infrastructure diagram | 4.11 | .80 | 82.35 |
| | 2. Education related to the work area | 3.88 | .72 | 72.35 |
| | 3. Income level of city people/income inequality | 3.79 | .84 | 75.88 |
| | 4. Racial, cultural and sexual equality | 3.50 | .96 | 70 |
| | 5. Using smart solutions to enhance access to services and facilities | 3.79 | .80 | 75.88 |
| | 6. The quality of housing in the current city | 3.82 | .71 | 76.47 |
| | 7. General well-being (life expectancy, morbidity and mortality rates) | 3.70 | .87 | 74.11 |
| | 8. Community safety and crime rate | 3.82 | .90 | 76.47 |
| Environmental | 1. Commitment to climate action | 3.94 | .91 | 78.82 |
| | 2. The rate of use of renewable energy sources | 3.94 | .88 | 78.82 |
| | 3. Waste recycling rate | 3.88 | 1.00 | 77.64 |
| | 4. Carbon dioxide emissions per capita through his use of toxic materials | 4.08 | .83 | 81.76 |
| | 5. Comfort level in current infrastructure | 3.79 | .94 | 75.88 |
| | 6. Satisfaction with the cleanliness of the city | 3.70 | 1.00 | 74.11 |
| | 7. Planning and design | 3.94 | .95 | 78.82 |
| | 8. Energy intensity of the economy | 3.82 | .71 | 76.47 |
| | 9. Total annual water consumption (cubic meters per capita, per GDP) | 3.64 | .77 | 72.94 |
| | 10. Use of ICT to manage, monitor and provide water (e.g. smart metering) | 3.85 | .89 | 80 |

The most significant indicators in the planning phase of the building project are displayed in Table (7). Starting with the economic index component of "Availability of skilled human resources," The growth of human potential in general and, to the greatest extent, the development of human resource potential are closely related to the effective implementation of the "smart cities" idea. Intellectual consumption is a prerequisite for intellectual creation. As a result, we assume that looking at human resource development from the perspective of a bilateral approach is methodologically advantageous. Every manufacturer of cutting-edge goods and services also uses an equally cutting-edge product. [28]

Although the most crucial component of the social traffic diagram is the infrastructure The movement toward smart cities and the increasing integration of many devices into daily life have made the acquisition of personal data a privacy concern. For instance, location data collection is necessary for an intelligent traffic management software that notifies users of traffic congestion. A major difficulty for smart city systems that process vast amounts of sensitive data is adhering to security and privacy regulations [29].

Cities that implemented smart roadmaps that integrated lower carbon dioxide ($CO_2$) emissions within the environmental sustainability agenda have the highest per capita carbon dioxide emissions through the use of toxic materials in the Environmental Index; however, it is unclear how closely the two issues have been connected. The study's conclusions imply that while efforts to reduce carbon dioxide emissions are part of the agenda for environmental sustainability, their definition is hazy in the context

of smart cities. In order to achieve "smart city" resilience, this article suggests a well-balanced approach that combines technology innovation, human talent, and "green" innovation. This tripartite approach is flexible and can be customized to meet the needs of communities, cities, and individuals. [30].

Table (8) Smart Cities Factors in Design Stage

| Factors | Items | Mean | Std. Deviation | RII |
|---|---|---|---|---|
| Economic | 1. The cost of designs prepared for smart cities | 4.32 | .58 | 86.47 |
| | 2. Innovation in designs | 4.29 | .62 | 85.88 |
| | 3. Flexibility in design to suit the environment | 3.94 | .69 | 78.82 |
| | 4. The competitive situation regarding prepared designs | 4.00 | .73 | 80 |
| | 5. Nominal GDP | 3.44 | .82 | 80 |
| | 6. Availability of skilled human resources | 3.91 | 1.02 | 68.82 |
| | 7. A variety of workplace options | 3.79 | .84 | 78.23 |
| Social | 1. Urban scope | 4.05 | .60 | 76.47 |
| | 2. Income level/income inequality | 3.67 | .76 | 81.17 |
| | 3. Racial, cultural and sexual equality | 3.47 | 1.02 | 73.52 |
| | 4. Using smart solutions to enhance access to services and facilities | 3.97 | .75 | 69.41 |
| | 5. Quality of housing | 3.94 | .85 | 79.41 |
| | 6. General well-being (life expectancy, morbidity and mortality rates) | 3.64 | .81 | 78.82 |
| Environmental | 1. Commitment to work in a manner consistent with the sustainable environment | 4.11 | .72 | 72.94 |
| | 2. Rate of renewable energy in buildings | 4.02 | .93 | 82.35 |
| | 3. Planning and design | 4.20 | .84 | 80.58 |
| | 4. Infrastructure and activities for environmental monitoring supported by information and communications technology | 4.02 | .86 | 85.29 |
| | 5. Energy intensity of the economy | 3.85 | .65 | 80.58 |
| | 6. Level of penetration of clean and renewable energy sources | 3.88 | .87 | 77.05 |
| | 7. Efficient management and use of energy (buildings, public spaces, etc.) | 4.02 | .83 | 77.64 |
| | 8. Use of ICT to manage, monitor and save energy (e.g. smart metering) | 4.20 | .88 | 81.17 |
| | 9. Water management plans and policies | 3.94 | .81 | 84.11 |
| | 10. Air quality index/pollution concentration levels | 4.05 | .60 | 79.41 |

As seen in table (8), the expense of creating designs for smart cities is deemed considerable in the economic indices. The most important consideration in the creation of a smart city is cost. Both operating and design costs are included in the price. One-time costs associated with smart cities are the design fees. The expenses needed to keep the smart city functioning are known as operation costs. The development of a smart city requires low design costs. Simultaneously, low operating expenses will facilitate long-term city operations with less strain on the local budget. Over the course of the whole system lifespan, cost optimization can be a difficult issue.[38]

Reducing operation costs and improving sustainability and efficiency require reducing carbon emissions and municipal trash. In order to maintain long-term sustainability and minimize operating expenses, smart cities must manage population growth. Smart cities must be able to withstand setbacks and calamities. Natural disasters can occur. Numerous factors, like ICT or power outages, might cause systemic failures. Natural catastrophes can potentially cause a number of smart city components to malfunction. These catastrophes and failures must be taken into account in any smart city design in order for smart cities to bounce back from such circumstances as soon as possible. These issues will have an impact on smart city design and operating expenses.

The efficient usage of several smart components, such as ICT, sensors, and IoT, makes smart cities conceivable. These cities will also require a lot of data to be processed and stored. Information and infrastructure security is a significant design problem. Most importantly, public safety poses a significant design problem for smart cities as resident safety is a top priority, which can also result in higher operating and design costs. [31,37,39]

The heist index in the social index is income level/income inequality. Because large information and communication technology (ICT) corporations provide municipalities with the technical solutions needed for Smart City projects to function, critics of the concept often base their concerns on the argument that promoting urban smartness entails increasing and exacerbating urban income inequality [32,33].

Information and communications technology supports the highest level of environmental infrastructure and monitoring operations. A smart, sustainable, and innovative city uses information and communication technologies (ICT) and other creative methods to improve the quality of life, the efficiency of urban operations and services, and the city's competitiveness while simultaneously satisfying the historical, societal, financial, and environmental needs of the burgeoning generations. A large number of people are moving from rural to urban areas in quest of better jobs and health. Technology for communication and information is essential to smart cities. By offering improved services, it raises the well-being of the population. Smart cities manage complexity while maintaining efficiency. [34,35,36,40]

## 4 Conclusion

The idea of a "smart city" has become relevant to building projects. Among the several building project stages, plaaning is said to be the most productive in smart cities. The concepts, norms, and ramifications of a smart city were covered in this study. To grasp the essence of the smart city concept, the traits and qualities are explained simply. After carefully analyzing several suggested smart city layouts, the general architecture of a smart city is explained before moving on to more technical specifics.

Issues including a lack of resources, degradation of the environment, traffic jams, and other safety risks are getting more and more attention. The concept of a "smart city" was developed to address the "urban disease" problem. Smart cities may successfully address the issue of "urban disease" as long as they fully integrate next-generation information technology, such as radio frequency( RF) sensing, cloud computing, Internet of things, and next-generation communication. The use of these technologies can facilitate the perception of the city and the complete integration of its resources. Based on this, it is possible to achieve the smart and efficient administration of the city, which will ultimately lead to the realization of sustainable development by reducing resource consumption, environmental pollution, traffic congestion, and potential safety issues. Ultimately, while the benefits of smart cities in construction projects are promising, addressing these challenges is crucial for realizing the full potential of these urban innovations. Successful smart city development will depend on collaboration between government, industry, and technology providers, as well as a commitment to sustainable and resilient urban growth. The planning stage consider the most important stage in developing the smart cities.

The major research future is the merging the IoT with smart cities in order to developed with less issues.

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