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# Smart Cities as a Newly Introduced Mechanism to Support the Goals of Sustainable Development

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**Abstract:**

Scientific and technological development has dominated various fields, to the extent that it has become, in most of them, a necessity without which life can hardly be imagined. Just as it has brought numerous benefits that have facilitated life, it has not been free from certain problems that have disturbed citizens' well-being, given the effective role that the city plays in the wheel of the economy, which has made it a strategic area for population concentration. This situation made it necessary to take control of matters before they went out of control.

In light of the challenges of achieving sustainable development, the idea of managing cities in a smart manner emerged as one of the newly introduced and adopted mechanisms. On this basis, the term "smart cities" appeared, which was considered a set of solutions to a serious and urgent situation that the world is currently facing. It has played an effective role in achieving what was planned for living in an environment that is almost safe from risks and with minimal damage.

**Keywords:** Artificial intelligence, Internet of Things, sustainable development, electronic management, innovations.

## Introduction:

Modern technology has worked to change all traditional concepts of the meaning of life that were previously known. This development, which has affected the global information network and communication technologies, has facilitated lifestyles and access to various social services, which has been positively reflected in improving the services provided to citizens in their cities of residence.

Given the important role that cities play in strengthening economic growth, and considering them distinguished places to live because they provide all life requirements, all this has made them a focal point for various problems, which necessitated efforts to find new approaches and methods to improve living conditions and to rid them of the various problems that have afflicted them as a result of unlimited scientific and technological development. Among the most prominent of these approaches is managing cities in a smart manner that preserves their

resources and makes optimal use of them. From this perspective, smart cities have come to be considered a global project toward which a group of developed countries has turned in order to meet challenges and engage in the world of globalization and advanced technology, as they seek to provide an environmentally friendly urban environment and a digital environment that contributes to stimulating creativity and learning. This is achieved through a new face of modern technology known as the Internet of Things, which has worked to overcome all the difficulties of life and make it easier at various levels.

From here, the following problem can be raised:

What constitutes the conceptual framework of smart cities? And where does their role lie in achieving sustainable development?

To answer this problem, we will address the conceptual framework in the first section, then the role of smart cities in achieving sustainable development in the second section.

**First Section: The Conceptual Framework of Smart Cities**

The concept of smart cities is undergoing continuous and very rapid development worldwide, as it works to provide an integrated digital environment that enhances the efficiency and security of urban cities. It aims to establish a comprehensive and advanced system that uses various geographic data related to the built urban environment and the natural environment[1].

"Smart cities are considered an engineering, conceptual, and forward-looking vision of the nature of life and the dignity of living in it, while preserving resources and environmental balance.[2]"

**First Requirement: The Concept of Smart Cities and Their Components**

Smart cities are among the innovations of the information technology era. Their concept is based on benefiting from information and communication technologies in urban management systems, in order to create cities designed to achieve sustainable development, rather than merely focusing on economic and social progress[3].

**First Branch: Definition of Smart Cities**

Legislation has not addressed the definition of smart cities; however, scholars in this field have attempted to establish a definition. They found that the term "smart cities" refers to cities that are equipped with modern and advanced communication services and information technology. They are referred to by several designations[4], which the European Parliament has linked to

seven patterns, represented as follows[5]: "Intelligent City, Knowledge City, Sustainable City, Talented City, Digital City, Eco City.[6]"

On this basis, definitions of smart cities have varied, as they constitute a subject of multidisciplinary research; they do not concern a single field, but rather reflect a diversity of domains[7], This made it difficult to arrive at a comprehensive and inclusive definition that encompasses all the meanings carried by the term "smart city." The term smart cities first appeared at the European Digital Conference in 1994, and later, in 1996, Europeans launched the digital city project in several cities such as Amsterdam and Helsinki[8].

The European Union defined smart cities as cities that bring together industry and citizens to improve life in urban areas and to achieve integrated and more sustainable solutions based on various applied innovations and the intelligent use of information and communication technologies[9].

According to the International Telecommunication Union (ITU), a sustainable smart city is an innovative city that uses information and communication technologies to improve quality of life, the efficiency of urban operations and services, and competitiveness, while at the same time meeting the needs of present and future generations with regard to economic, social, environmental, and cultural aspects[10].

Azamat (Cyprus, 2011) defines it as an urban agglomeration based on three pillars, namely the technological, environmental, and social pillars.

**The technological pillar** refers to the digital and virtual city, which is equipped with information and communication technologies as the fundamentals for operating a smart society and smart urban management.

**The environmental pillar** refers to a city that uses new and renewable energy resources.

**Finally, the social pillar** refers to a city based on knowledge-based and creative activities of individuals and institutions, as well as technological and digital communications and knowledge management[11].

The Smart Cities Workshop (2009) defined it as a city that makes conscious efforts to employ information and communication technologies in an innovative manner to support a more inclusive, diverse, and sustainable urban environment[12].

It is also defined by the American-Canadian federal government (CFG – Canadian Federal Government) as communities in which—through the use of electronic networks and the Internet—stakeholders and local leaders form alliances and partnerships for the purpose of innovation and the creation of new economic and social value.

Despite the variation and differences among scholars' definitions, they share three fundamental aspects: the means of communication, which include network infrastructure based on information and communication technologies; the process, which relies on networked linkage among various actors; and finally, the objective sought to be achieved through their adoption[13].

**The second branch: Components of smart cities.**

A smart city is based on a set of foundations and components through which the application and activation of sustainability characteristics in all their dimensions are achieved, such that these foundations and components are primarily linked to the structure of information and communication technologies[14], Ultimately, these cities are integrated across three main levels, which are essentially represented by knowledge-based activities, problem-solving institutions, and finally digital communications infrastructure[15].

They are represented by:

**Smart individuals:** These refer to individuals who must possess a sufficient level of qualification, have the capacity for lifelong learning, social and cognitive diversity, as well as flexibility and creativity, enabling them to adapt to an environment whose interactions are based on the Internet, smart mobile devices, and their applications.

**Institutions:** Through these, services are provided to distance education institutions. These services include technical support through the provision of learning management systems and electronic platforms for lectures, administrative services, as well as academic services. This enables distance education institutions to deliver flexible and effective education while ensuring easy access to educational resources and related services.

**Wide-area wireless networks (Wi-Fi):** These are networks that use radio waves to exchange information instead of wires and cables. They are characterized by high data transmission speed and the ability to penetrate barriers and walls[16].

**Applications:** These are the means for using Internet services and include wireless smart devices such as mobile phones, tablets, and others.

**Content and data management tools (databases): Such as CAD, GIS, and Internet-based tools like virtual collaboration tools.** These represent one of the most important components of smart cities, as they collect data from government systems, wireless smart devices, and Internet applications, then analyze it and transform it into value-added activities for decision-making and problem-solving[17].

**The second requirement: Characteristics and objectives of smart cities.**

Smart cities have a set of characteristics that distinguish them from other previously known cities, and they also have a set of objectives they seek to achieve. Both will be addressed in this section.

**The first branch: Characteristics of smart cities.**

The characteristics of smart cities are numerous, the most prominent of which are the following:

**First – Smart e-government:**

It is a newly emerging system adopted by various governments, where the World Wide Web and the Internet constitute its foundation in linking governmental institutions to one another, and then linking their various services to institutions in particular and to citizens in general. Consequently, information becomes available to them with speed, accuracy, and quality of performance, creating a form of transparency[18], The development of e-government takes place through several axes, namely:

- **Information provision:** This is achieved through the availability of information and events related to city residents, making them accessible to everyone.
- **Communications:** This is embodied in the ability to communicate between the government and residents, as well as its ability to exchange information.
- **Electronic transactions:** These consist of providing various services electronically, such as signing applications and the electronic delivery of official documents and papers, among others[19].

**Second – Smart mobility:**

This refers to intelligent movement, whereby smart transport and mobility systems are provided through various advanced technologies that rely primarily on information technology. These systems, in turn, help enhance the quality of transport services, improve their efficiency, ensure

the safety of individuals on roads, and offer many solutions to mobility problems in different cities[20].

**Third – Smart buildings:**

These refer to the integration of networks and electronics into various city buildings, which helps reduce and lower annual operating costs, particularly those related to energy management and water consumption[21], Its primary objective is to provide complete comfort for residents, as these buildings are equipped with sensors, networks, and computers used to collect and provide information. This enables, for example, the identification of visitors and owners through voiceprint recognition or facial features, which in turn transmit unregistered information to the homeowners' personal assistants or to security authorities to verify the absence of any intrusion, among other smart services[22].

**Fourth – Smart economy:**

The smart economy refers to a global structure based on the use of information and communication technologies. It is considered the adopted approach in dealing with various activities such as e-tourism, e-commerce, and others[23]. It is embodied in the spirit of innovation, business growth, productivity, labor market flexibility, adaptability, and branding[24].

**Fifth – Smart society:**

Also referred to as smart people, this involves preparing human resources capable of continuously developing and improving applications, in order to enable all users of these applications to benefit from them effectively by providing a minimum level of skills and technological awareness[25].

**Sixth – Smart living:**

This includes cultural facilities, health conditions, individual safety, tourist attractiveness, social cohesion, educational facilities, and housing quality[26].

**The second branch: Objectives and motivations of smart cities**

Smart cities have a set of objectives and motivations, which can be summarized as follows:

**First: Objectives of smart cities**

The objectives of smart cities are numerous and include the following[27]:

- Enabling the smart city to access public services, carry out electronic transactions, and access various databases.
- Establishing a digital economy whose backbone is communication networks and information technologies.
- The emergence of a new lifestyle and a new work environment that keep pace with the rapid rhythm of the information age.
- Improving the level of administrative, economic, and social services in the smart city and increasing their effectiveness.
- Creating new job opportunities that differ from those found in traditional cities, such as programmers, data entry operators, and information specialists, in line with work in the smart city.

All of this is summarized by the Director of Sustainable Development of the Bouygues Group, Fabrice Bonifet, in his statement: "The objective of the smart city is that the sub-components of the city's sovereign service activities can be used more systematically by other economic actors within the framework of a circular economy, instead of being wasted.[28]"

**Second: Motivations of smart cities**

The transition to smart cities is not optional; rather, it is governed by several motivations, including the following[29]:

• **Social motivations:** These arise from the problems caused by demographic growth, whether in terms of density or population distribution, as people concentrate in areas with better living conditions. This has led to unplanned urban expansion, a decline in living standards, and the emergence of various problems related to housing, rising unemployment rates, and even crime, resulting in a somewhat monotonous and unsafe way of life.

• **Economic motivations:** This aspect has played an effective role in the emergence of new cities, as most areas with diverse potentials and resources have been exploited to establish them, thereby achieving societal goals and promoting the economic development of urban areas.

• **Natural motivations:** These relate to the various challenges that have faced and continue to face the urban environment, leading to environmental degradation. Smart cities work to preserve a clean, green (sustainable) environment by adopting developmental approaches that make them more sustainable and environmentally friendly.

**The second section: On the role of smart cities in achieving sustainable development.**

In view of the recent population growth witnessed worldwide, and the desire to concentrate in places where decent living conditions are available and all essential life needs are met, an imbalance has emerged in population distribution. Wherever populations have become dense, crimes and problems of all kinds whether social or economic have appeared. Housing problems have also emerged with the rise of new, unplanned neighborhoods, causing cities to suffer from pollution that has affected citizens' lives. On the other hand, the world as a whole has entered a technological revolution and an unprecedented scientific and informational development. Most orientations have therefore moved toward investing in this transformation as a means of proposing solutions to the problems facing cities. This led to the emergence of a new urban model known as smart cities, which are characterized by their alignment with the objectives of sustainable development[30].

**The first requirement: The concept of sustainable development.**

The term sustainable development emerged in 1987 following the issuance of the report entitled "Our Common Future" by the World Commission on Environment and Development, established by the United Nations in 1983. After the emergence of this term, the United Nations worked to transform it from a theoretical concept into practical application, which was achieved in 1992 with the convening of the United Nations Conference on Environment and Development, known as the Rio de Janeiro Declaration, in Brazil[31].

**The first branch: Definition and principles of sustainable development.**

**First: Definition of sustainable development.**

According to Law No. 03/10 dated 19 July 2003, relating to the protection of the environment within the framework of sustainable development, sustainable development is defined as social and economic development that is capable of continuity while protecting the environment; that is, integrating the environmental dimension within a development framework that ensures the fulfillment of the needs of present generations and future generations.

In other words, it is the convergence of a set of efforts aimed at achieving a balance between social and economic development in a manner that is sustainable, unlike traditional approaches long known for their impermanence and their harmful effects on the environment. Sustainable development was once a theoretical concept and has become a practical one, working to protect

the environment while meeting the needs of present generations and preserving the right of future generations to meet their own needs.

**Second: Principles of sustainable development.**

Sustainable development can only be achieved through the integration and interconnection of its economic and social dimensions. The absence of either of these inevitably has a negative impact on the economic dimension.

Through the economic dimension of sustainable development, it can be concluded that it "aims to halt the depletion of underground and surface economic resources and to promote rational and prudent consumption of economic capacities."

As for the social dimension, it aims to achieve social justice and satisfy individuals' needs by improving income so that it is sufficient and constitutes a foundation upon which the goal of improving living standards is built. This dimension is also related to everything social within society, such as health, education, upbringing, and housing.

Finally, we come to the environmental dimension of smart cities, which is essentially based on a development principle represented by resilience, or the ability of the ecosystem to preserve its ecological integrity, as well as its capacity to adapt something that inevitably leads to the protection of natural resources necessary to ensure the safety of individuals[32].

**The second branch: Objectives of sustainable development and its principles.**

**First: Objectives of sustainable development.**

Sustainable development seeks to achieve a set of objectives that can be presented as follows[33]:

• Achieving a better quality of life for citizens through planning processes and the implementation of development policies.

• Emphasizing the strengthening of the sensitive relationship between humans and the environment, by dealing with various natural systems and their components as the foundation of life, and striving to make this relationship one of integration and harmony. Its basis is the rational use and exploitation of resources to ensure social and economic sustainability.

• Working to link modern technology with the objectives of society by raising residents' awareness of the importance of various technologies in the developmental field and how to use them to improve quality of life.

**Second: Principles of sustainable development.**

The principles of sustainable development encompass broad concepts and are primarily represented in improving living standards and reducing poverty, in parallel with preserving and protecting the environment through the conservation of various natural resources.[34] The Rio Declaration set out 27 principles, the most important of which are:[35]

• Making human beings the foremost priority in sustainable development, focusing on enabling them to live healthy and productive lives in harmony with nature.

• Sustainable development also emphasizes the necessity of realizing the right to development in a manner that fairly meets the developmental and environmental needs of present and future generations.

• Environmental protection must be an integral part of the development process and cannot be considered in isolation from it.

• Cooperation among states and peoples to reduce and eradicate poverty as an indispensable requirement for sustainable development, in order to reduce disparities in living standards.

• Cooperation among states to conserve, protect, and restore the health and integrity of the Earth's ecosystem.

• Cooperation among states to strengthen self-capacity building for sustainable development by enhancing scientific understanding through the exchange of scientific and technological knowledge.

• Peace, development, and environmental protection are interrelated and indivisible.

**The second requirement: Challenges of sustainable development and the role of smart cities in achieving it.**

Sustainability constitutes the core foundation behind the emergence of smart cities, as a traditional city cannot reach the stage of intelligence without applying the principles of sustainability within it. The concept of a sustainable city is based on achieving specific objectives aligned with environmental, economic, cultural, and social visions[36], which sustainable smart cities have sought to achieve despite the various challenges facing sustainable development in this field.

**The first branch: Challenges of sustainable development.**

Sustainable development has faced a set of challenges, the most significant of which have been embodied in the main axes upon which the foundations of sustainability were built, namely social, economic, and environmental challenges.

**From the environmental perspective,** pollution has been the greatest challenge to humanity in general and to the objectives and dimensions of sustainable development in particular, especially that resulting from the emission of various toxic and lethal gases. One researcher in this field pointed out that the risks of pollution are certain across many generations, yet they remain unknown and cannot be precisely identified for prevention, as they are subject to significant scientific uncertainty regarding the intensity of pollution and its production.

**As for the economic level,** the greatest challenge to the sustainable development process has been the aggravation of economic crises, whose effects have been reflected in the objectives of sustainable development. This has resulted in rising unemployment rates, which contradict the dimensions and goals of sustainable development aimed at improving living standards[37].

We also find the issue of industrialization, as it is considered one of the most important pillars upon which states are built. However, it inevitably affects resources and reduces the share available to future generations, and it will certainly contribute to environmental pollution as previously mentioned.

**Finally, from the social perspective,** we observe significant demographic growth, especially in third-world countries, which has become a major obstacle to the development process. This has led to an increase in poverty, which sustainable development seeks to eradicate completely from societies[38].

**The second branch: The need for smart cities and their effective role in achieving sustainable development.**

The role of smart cities in achieving sustainable development is of great importance, based on the findings of various studies that have affirmed the significance of moving toward smart cities in pursuit of sustainable development. The objective of sustainable development is to meet aspirations for a decent standard of living within societies, achieve the principles of equality and justice, and reduce environmental degradation. Smart cities have therefore emerged as one of the most important models for bringing about change, especially in light of the extensive global preparedness witnessed worldwide. They have capitalized on this by relying on information and communication technologies and making them the foundation for achieving

the Sustainable Development Goals set by the United Nations for 2030, with particular attention to building resilient infrastructure, promoting sustainable industrialization, fostering innovation, advancing education, achieving equality, and strengthening global cooperation to realize sustainable development[39].

Smart cities have worked to achieve sustainable development goals through several elements, which are presented here by way of example[40]:

• **Smart water:** This concept refers to the existence of infrastructure for managing drinking water and wastewater that ensures their efficient management, as well as the energy used to transport them.

• **Smart mobility:** This consists of smart technologies adopted by cities with the aim of improving journeys and providing alternatives for residents. These technologies enable the detection of potential deterioration in traffic signals and pedestrian lighting systems, identify intersections and black spots where traffic accidents are frequent, and encourage citizens to use public transport instead of private vehicles. The goal of smart mobility lies in contributing to smoother traffic flow while also preserving the environment. Accordingly, some cities have moved toward the adoption of electric vehicles to eliminate emissions produced by conventional vehicles.

• **Smart waste management:** This represents one of the challenges facing cities, with the aim of improving urban waste collection services. Due to the high cost of this process, many cities have introduced smart solutions for waste management, most notably the development of smart bins powered by solar energy and equipped with sensors to continuously compress accumulated waste.

• **Smart security:** This is achieved by relying on security agencies in cities on cameras equipped with the latest technological technologies to detect crimes and criminals without the need for security personnel in streets and neighborhoods, thereby achieving security and stability.

**Conclusion:**

In conclusion, it has become clear that moving toward smart cities is no longer an optional choice for states to adopt or not; rather, it has become an inevitable necessity. It is among the most important issues that have preoccupied various countries in this era, as it has become closely linked to the dimensions of economic, social, and environmental development. This

trend has imposed itself despite all the challenges it has faced and continues to face in a manner that works to meet individuals' needs while preserving the needs of future generations, within the framework of embodying the requirements of sustainable development and linking all of this to communication technologies and information technology. Smart applications, smartphones, and all portable electronic devices have come to play an important and central role in these cities, as they provide real-time information on transport services, health services, security alerts, traffic movement, and others. Accordingly, many countries are striving to make their cities smart cities and to link this transformation to the achievement of sustainable development goals.

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