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The conceptual framework for smart cities and ways to transform them

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Abstract

The new century has brought with it many new cultural terms and concepts whose meanings flirt with the concept of global technology, including (the electronic city, the global city, the information city, the virtual city, the smart city, etc.), which are modern terms based on the principles of the contemporary technological revolution. The concept of the "virtual world" available on the Internet has provided citizens and decision-makers alike with ample space for mature thinking on how to put modern technology

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at the service of urban growth. Discussions began about the possibility of constructing smart buildings that integrate environmental systems, energy use, and communication systems, until this approach to building design became popular, as it is compatible with modern technology.

Keywords: smart cities, transformation, technology, regulation.

1. INTRODUCTION

The concept of the smart cite is part of the strategies of many developed and developing countries, as it is considered a crucial vision of contemporary urbanization. The term "virtual city" was first used by writers Graham and Aurigi in 1997, who believed that there were more than 2,000 cities on the Internet that year, carrying with them a spatial simulation of their services[1] The International Organization for Standardization (ISO) has defined smart cities as a new model of cities that use information technology (the Internet,

[1] Springer International Publishing AG,(2017) "The Rise of the Smart City " L.G. Anthopoulos, Understanding Smart Cities: A Tool for Smart Government or an Industrial Trick? Public Administration and Information Technology 22.
http://www.springer.com/978-3-

computers, digital data, virtual space, and geographic information systems (GIS)) as an approach to urban planning, construction, and management. The European Commission's FP7-ICT program, on the other hand, views smart cities is "an environment for open innovation governed by the user, thereby enhancing the citizen's ability to participate in shaping important decisions about their environment"[2] While some believe that governments and urban administrations in smart cities have a responsibility to ensure that the city's community enjoys advanced information and communication services, and that smart cities strive to put their citizens and businesses in a state of prosperity and progress, They must also establish advanced communications and information technology infrastructure to gain competitiveness and attract industries capable of creating a knowledge-based economy.

There is a clear relationship between urbanization and the information revolution, as rapid urbanization contributes to the

[2] Fouad Ben Ghadban, Cities of Knowledge and Smart Cities, Dar Safaa Publishing and Distribution, Jordan, 2017, p. 215.

sustainability of cities and adds a range of challenges at the city level, including the expansion of poverty, social pressure, urban pollution, and a shortage of natural resources. This, in turn, increases the demand for economic, social, environmental, and technological development, especially in countries with low average income levels, which are experiencing an increase in urbanization rates. Therefore, every city needs to adopt solutions to address the phenomenon of rapid urbanization and ways to control it in accordance with modern information technology. In this way, the city will enter the world of technology, whether it learns or not, to solve its problems.

Some believe that concepts such as participation, integration, and well-being can only be achieved in a city that uses information technology to manage all its activities and by all its citizens. In this way, each of its urban activities is fully aware of the work of other activities. More precisely, the output of each institution is visible to the rest of the city's institutions in order to ensure that the needs of its citizens are met on the one hand and to create a competitive environment between its activities on the other.

Based on the above, we can see that the smart city is a city of technology, and indeed the city of the near future, based on the principle of informatics and the virtual space made available by the international information network (the Internet) with its virtual spaces and its interconnection with existing reality, achieving a strong interconnection between reality and the available technology for cross-border and cross-continental communications.

The smart city model provides each part of it with a clear and accurate view of the other parts, achieving integration in performance. Thus, the city and its institutions are under the control of the user, regardless of their identity and geography. The smart city experience does not differ in form and structure from the cities we know, but the secret lies in the difference in its structural systems and its ability to export its services and functions to the virtual world. The signs of urban adaptation began to appear clearly in response to the obvious flow of information that people need around the clock, seeking to update it and innovate new ways to display and deal with it. The city thus took rapid steps that achieved great achievements in

terms of transformation and response on the one hand, and performance and handling on the other.

Artificial intelligence has had a profound impact on the development of smart city technologies and the speed of their transition to the digital world. It has enabled the integration of urban institutions and their systems through visual communication, giving cities a persona other than their physical presence on the ground. In fact, the virtual persona of a city has taken on new characteristics that are distinct from its physical attributes.

The question that arises is: what is the concept of smart cities? And what are the ways to transition to them?

To answer these questions, we decided to divide our study into two parts, dedicating the first part to defining the concept of a smart city and the second part to the frameworks for transitioning to a smart city.

2. Title : Defining the concept of a smart city.

The principle that makes a city smarter and more integrated is its ability to promote itself through rapid information transfer media

and its various means governed by a network of information and digital flows (the Internet). If the city can break into this information network and introduce digital technology into its work, management, and monitoring, it will become a smart city par excellence. As for the temporal dimension provided by smart cities, they provide their databases at all times, day and night, during holidays and all tourist seasons, etc., in a way that allows users to benefit from services whenever they want[3]. The intelligence of cities is based on the extent to which they deal with artificial intelligence and its applications in urban areas. Here, we can outline the most prominent features of a smart city:

- It has multiple accounts and websites.

- It maintains constant electronic communication with consumers.

- All its data is digital and stored in various information packages.

- It has a sophisticated and up-to-date database (urban,

[3] Bassam Samir Al-Ramidi, Egypt's new administrative capital as a leading model for smart cities in Africa, book of the First International Maghreb Conference on Sustainable Development Updates, organized from March 12 to 16, 2021, Egypt.

demographic, planning, etc).

- It has a digital management team that oversees its digital transformation process.

These digital features help the city break into the virtual world with great merit and speed, enabling it to impose its personality.

2.1 First Subtitle ; The need for smart cities.

Now that information technology has taken control of various aspects of life and dominates all dimensions of the human landscape, cities cannot remain outside this landscape. Therefore, urban planners have rushed to produce new software and planning methods that keep pace with these technologies to serve their residents and visitors.

Its detailed maps have evolved into high-precision smart electronic maps that can be continuously updated using advanced GIS software and its various applications, in addition to marking all its locations, institutions [4], and land use systems on this type of map with a 3D

[4] M. Evren TOK, Maha Al MEREKHI, Hanaa Al GHAISH, Fatima MOHAMED ALI (2014) "SMART CITIES IN QATAR AND UNITED ARAB EMIRATES, A COMPARATIVE ANALYSIS" The Journal of Academic Social Science Studies.

system supported by live images and videos that allow the user to zoom in on each part of it with high accuracy.

Remote sensing technology provided by satellite systems through a large collection of satellite imagery now supplies control and processing centers, with an accuracy of less than 3 cm in representing different terrestrial scenes. In addition to enabling users to request any live satellite imagery for any geographical location within its spatial scope, GPS technology has greatly improved location identification by connecting to satellites with software that allows users to move around, access, and inquire about any location inside or outside the city at any time.

The development of websites and their accounts, along with their high potential, has whetted the appetite of the information city to enter this vast virtual world, take its place in it, and integrate with its predecessors. It can be said that all cities around the world have begun this stage of digital transformation, but at varying rates and levels determined by the type of city, its urban capabilities, and the policies of its decision-makers, which determine the speed of its

access and interaction with this wo**rld.**

2.2 Second Subtitle : Smart city components.

Contemporary technology has imposed many new requirements for building smarter cities than before. For a city to become a smart city, the following components must be available:

1- Smart Government:

Smart government refers to enabling new forms of e-government that rely on new methods of governance and advanced models of virtual reality simulation, with technical management capable of dealing with the city's variables informatively, making this government more transparent.

2 - Smart infrastructure:

It is a complex and expensive system of electronic technical requirements, radio stations, transmission centers, high-precision networks, computer hardware, telephones, and computers. This type of service is known as "telematics" and is often located underground, functioning as a large machine with lines reaching every home,

building, and institution[5].

3 - Smart mobility:

Smart mobility is achieved through smart, multimodal transportation systems that move, exchange, use, and keep data secure. The smart infrastructure of cities relies on the power of connectivity and live streaming via fiber optics to transfer data across networks that need a fast system for transferring digital data packets between users and e-government.

4 - Smart user:

Urban users should be more aware, creative, and inclusive of all smart city variables and infrastructure to achieve the principle of empowerment, active participation, and maximum benefit from available city services, ensuring their right to participate in decision-making.

[5] Kouach Zahia, Wakli Kalthoum, Experiences and Applications of Smart Cities in the Arab Region – United Arab Emirates and Smart Dubai, Economy and Environment Magazine, Volume No. 02, 2019, p. 98.

2.3 Third subtitle: Smart City Software.

A smart city has tools that embody its dimensions on the ground. These are not traditional, readily available means, as some may believe, but rather a complex network of advanced systems and software that work in an interconnected and effective manner to transfer urban activities from the real world (the physical world) to the virtual world (the digital world). More precisely, no city can be smart unless it is able to transfer its urban uses and functions and convert them into digital data, images, and virtual clips that simulate actual use on the ground. This cannot be achieved unless it is based on advanced digital technology that enables it to perform this role.

Smart city tools are sophisticated electronic software programs that run on modern computers and have the ability to transform the physical structure and functionality of a city into a structure and functionality within the invisible virtual world. The most prominent of these software programs are as follows:

1 - Remote sensing technology:

Remote sensing is a technology for obtaining data and measurements of an object or phenomenon without physically

touching it. Cameras, shortwave scanners, and electromagnetic spectrum measuring devices are systems for collecting information using this technology. This technology (satellite imagery) provides high-resolution images of all surface phenomena in various sizes, measurements, resolutions, and dimensions, and helps obtain the appropriate information for any area to be studied, whether natural or human. These satellite images are taken by a group of satellites that continuously orbit the Earth to provide extensive coverage of different areas of the Earth.

Today, this technology is heavily relied upon in the field of urban applications and the availability of vast amounts of urban data about cities and their various facilities, as well as in many areas such as housing, tourism, entertainment, transportation, energy supply, desertification, and others.

These satellite images provide high-resolution aerial photographs and accurate digital maps of routes and directions for all urban uses in the city, resulting in a digital simulation of these uses and locations on the Internet that is constantly updated and developed, providing

users with a modern and high-resolution view.

2 - Global Positioning System:

The most prominent satellite-related technologies and software provide computers with accurate information about any location on the Earth's surface using positional coordinates and time. This technology allows data to be linked to laser rangefinders and high-resolution digital cameras. This technology also helps specialists identify any location in the city and its vital facilities and download it onto digital maps with an accuracy of 1-10 meters, and in some cases, the accuracy of its data reaches 3 cm. This technology contributes to smart city projects by providing urban maps with accurate location coordinates that can be used to identify any point on the city's surface and deal with it digitally.

3 - Geographic Information Systems:

The most prominent information technologies that deal with specialized data rely primarily on computers in their work. They consist of software and hardware used to collect, convert, process, and link data digitally. They are linked to their geographical reality and have a high capacity to handle data in high-precision digital and

cartographic formats and formats. It also has the ability to produce virtual digital maps of all city locations and their uses, and has features that display land uses in the city on multiple service layers[6].

4 - Remote city monitoring and control technologies:

One of the characteristics of a smart city is that it is capable of monitoring itself technologically through a network of sensors and digital cameras that provide an adequate level of monitoring, control, and guidance for its residents, security, and economy through observatories (urban, security, planning, etc.) whose purpose is to monitor and investigate the city's condition, movement, and maintenance around the clock. There are many specialized software programs that can handle spatial variables occurring in the city remotely via satellites or guided aircraft connected to permanent monitoring rooms set up for this purpose. This type of technology also ensures the security of city information from digital tampering, viruses, spyware, eavesdropping, and other electronic hacking

[6] Thaer Mazhar Al-Azawi, Introduction to Geographic Information Systems and Data, Dar Hamid Publishing and Distribution, Jordan, 2008, p. 125.

operations that many websites linked to city institutions and administrations are exposed to.

3. Title : Frameworks for the transition to a smart city.

The transition to a smart city is complex and multidimensional, and the transformation process depends on the collective integration of a range of factors.

There are many factors that influence the design and implementation of smart city initiatives, which contribute to their success. These factors are as follows.

1 - Management and organization:

Smart city initiatives, like government initiatives, face a number of administrative and organizational challenges, which can be summarized as follows:

- Project size.

- Attitudes and behavior of managers, users, or organizational diversity.

- Lack of alignment between organizational goals and the project.

- Multiple or conflicting goals.

- Resistance to change and conflicts.

In response to these challenges, various strategies can be employed, including:

- Project team skills and experience.

- Technical and social skills.

- Setting clear and realistic goals.

- Identifying relevant stakeholders.

- Involving end users in the planning process.

- Adequate and innovative funding.

2- Technology:

Information and communications technology (ICT) is the main driver of smart city initiatives, as smart cities rely on a range of smart computing technologies applied to critical infrastructure components and services. Intelligent computing refers to "a new generation of integrated hardware, software, and network technologies that provide IT systems with real-time awareness of the

real world and advanced analytics to help people make smarter decisions about alternatives and actions that will improve business processes and bottom-line results"[7].

However, the use of technology in smart cities faces many challenges, including:

- IT training programs.

- Lack of employees with integration skills and culture.

- Lack of cooperation between sectors.

- Lack of coordination between departments.

- Unclear vision for IT management.

3- Governance:

Smart city initiatives seek to provide better services to citizens and improve their quality of life. This is achieved through projects involving multiple stakeholders.

Many cities have benefited from the emergence of information and

[7] Ahmed Naguib Abdel Hakim Al-Qadi, Muhammad Ibrahim Al-Iraqi Characteristics of Smart Cities and Their Role in the Transition to Sustainability in Egyptian Cities, International Journal of Architecture, Engineering, and Technology, Iraq, 2012, p. 163.

communication technologies that improve their governance. This IT-based management is known as smart governance. It broadly represents a set of technologies, individuals, policies, practices, resources, social norms, and information that interact to support city management activities. Smart governance is at the heart of smart city initiatives and therefore represents an important challenge for smart city initiatives.

4- Politics:

The transition from a normal (non-smart) city to a smart city involves the interaction of technological components with political and institutional components. Political components represent various political elements (city council, city government, and metropolitan area) and external pressures such as political agendas that may influence the outcomes of IT initiatives. Institutional readiness, such as the removal of legal and regulatory barriers, is important for the smooth implementation of smart city initiatives.

5- Individuals and communities:

Addressing individuals and communities as part of smart cities is crucial, as smart city projects affect individuals' quality of life and aim to encourage more informed, educated, and engaged individuals.

Smart city initiatives need to be sensitive in balancing the needs of different communities, such as the digital divide, information and community gatekeeping, participation and partnership, communication, education, quality of life, and accessibility.

6- Economy:

It is the main driver of smart city initiatives, and it is believed that a city with a high degree of economic competitiveness has one of the characteristics of a smart city. Therefore, one of the main indicators for measuring growing competition in a city is its capacity as an economic engine.

The economic outcomes of smart city initiatives are business creation, job creation, workforce development, and productivity improvement.

7- Infrastructure:

Infrastructure plays a crucial role in making smart cities a reality. ICT

infrastructure includes wireless infrastructure (fiber optic channels, Wi-Fi networks, wireless hotspots, and kiosks) and service-oriented information systems.

The implementation of ICT infrastructure is essential for the development of a smart city and depends on certain factors related to its availability and performance.

8- The environment:

Smart city initiatives look ahead in terms of the environment. The essence of the smart city concept is to use technology to increase sustainability and improve the management of natural resources. It is crucial to protect natural resources and related infrastructure such as waterways, sewers, and green spaces such as parks. Together, these factors affect the sustainability and well-being of a city, so they must be taken into account when examining smart city initiatives.

4- Conclusion:

We can conclude from the above that the concept of the smart city is essentially a new idea that has emerged as a result of the digital

technological development that our world is experiencing today thanks to the information revolution that resulted from the development of the Internet revolution, which has been reflected in various areas of life and its human aspects. The smart city model achieves many contemporary urban advantages, most notably:

- Creating rapid communication and cultural integration with other societies at lightning speed, simply by pressing a button on social media devices, ensuring rapid development of their reality, which aspires to highlight its positive aspects to the world.

- Achieving a high level of transparency and credibility in conveying the urban landscape to consumers without exaggeration or speculation through electronic maps.

– Virtuality that reflects its urban character and services for both residents and visitors.

- Smart cities ensure that their residents participate in planning decisions by identifying the mistakes and shortcomings of officials, highlighting the positives, and proposing appropriate solutions. This means that decision-makers are in constant consultation with the consumers of city services.

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