

Orientation towards Using Smart Technical Solutions in New Cities, Case Study: Noor-City, New Administrative Capital in Egypt

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Abstract:

Cities utilize between 60% and 80% of the world's energy consumption and produce over 70% of its carbon emissions. Numerous problems, such as water pollution, energy consumption, and traffic congestion, have been brought about by rapid urbanization. Smart cities around the world are looking to harness the power of technical solutions in order to become more efficient and improve the lives of their citizens. The results were able to automate repetitive tasks, such as automated devices, Smart Building (SB) and Smart Transportation System (STS). This paper aims to provoke the design of future cities into smart sustainable cities; to providing resources and streamlining, while simultaneously granting tools that assist via more challenging problems like pollution control and public safety. The relevance is to face and develop cities by allowing them to optimize their resources, reduce costs, and improve service delivery; as a part of Smart Digital Sustainable City (SDSC) while preserving the Smart Safety and Security (S3) and the Smart Renewable Energy (SRE) to improve air quality, reduce water consumption and monitor noise levels in urban areas. This paper exposed Noor City as an iconic case-study for smart cities in the Middle East region, and to adopt smart methods and technical solutions in the new administrative capital in Egypt; to tackle a framework for the cities to be more digital and smarter.

Keywords:

Smart Cities (SC), Smart Building (SB), Smart Renewable Energy (SRE), Smart Transportation System (STS), Smart Safety and Security (S3), Smart Digital Sustainable City (SDSC).

Paper received November 5, 2023, Accepted December 25, 2023, Published on line March 1, 2024

1. Introduction:

The development of communication and information technologies marked the end of twentieth and the start of the twenty-first centuries' technological development, which was primarily reflected in how people lived and went about their daily lives.

As a result, a new pattern of society emerged, one in which most activities are dependent on modern technologies. This technological advancement has influenced the way that cities are conceptualized. These cities rely on technology because it offers people and society interactive services. Since the foundation of these cities is sustainability, the technological solutions currently in use are no longer adequate to meet the demands of these urban areas, especially considering the quick advancement of smart technologies.

This paper determinates the concept of smart cities is missing, the tardiness of its introduction and adoption in Egypt, as well as the elucidation of the function of contemporary technologies and the degree of their influence on emerging cities. In addition to the lack of support for these contemporary technologies in every city, which makes it difficult to meet the difficulties that new cities will face in their establishment.

Subsequently this paper attempts to accomplish the primary objective, which is the integration of smart technologies into future cities, identifying the tools required for accomplishing the above, investigating the processes and strategies for incorporating intelligence into cities, and emphasizing the

significance of incorporating those cities' applications into future development plans.

Methodology:

Research methods employed in this research vary considerably depending on the aspect of analytical approach, deductive and applied methods. The analytical approach to review the justifications for the need to go to smart cities, which is the increase in the population, which led to the emergence of bad social and environmental effects; towards finding solutions to these problems, it is necessary to turn to smart technical solutions. In particular, the use of information and communication technology in the field of developing infrastructure and services.

Following that; the deductive method discusses the concept of smart city and its requirements and needs, ways to meet the design challenges in new cities using smart technologies and the possibilities offered by smart technologies to create smart cities. Finally the applied method settled Noor city as one of the most important smart cities not only in Egypt; but in the Middle-East region. Thus, the importance and recommendations for the application of smart technologies and solutions in the future smart sustainable cities.

3- Smart cities technological framework elements

The concept of smart cities became entangled with other concepts like intelligence, ubiquity, knowledge, information, and digitalization as it developed to meet the demands of policymakers and urban development. Essentially, the goal of

implementing smart cities is to use technology to improve citizen-government interactions in terms of transparency, accountability, efficacy, and efficiency. The creation of sustainable, effective, and liveable urban environments for inhabitants is the overarching goal of almost all smart city initiatives. However, because different people have different interpretations of what a smart city is, there can be significant differences between the proposed frameworks for smart city development (1)

3-1 Dimensions of smart future cities:

Challenges encountered in determining the term Smart Cities (SC) are a reflection of the difficulties in identifying its constituent elements. Scientists agree on the number of dimensions that smart cities encompass, despite the lack of agreement regarding the definition of this concept (2). It's widely accepted that a city qualifies as smart if it possesses the characteristics as shown in the following figure 1;

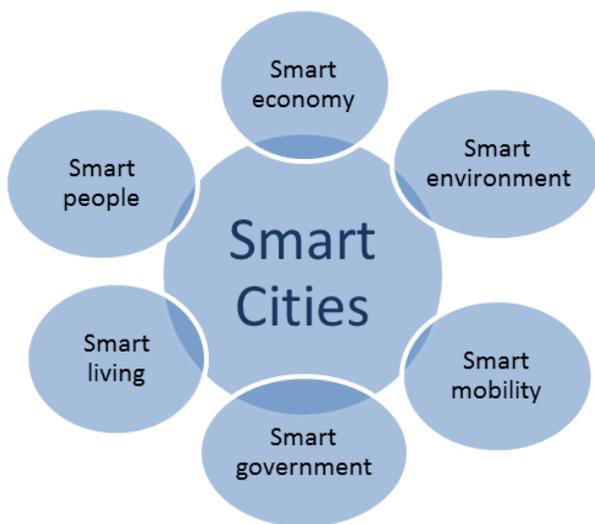


Fig. 1: Dimensions of smart cities, By: Dorota Sikora-Fernandez, Year:2016

To the time currently being, smart cities can be declared to be smart if they possess the following six elements and dimensions:

- 1- Smart Economy: cities should have high productivity based on the application and fusion of knowledge-based production methods, an innovative environment, and a flexible market.
- 2- Smart environment: smart city minimizes waste emissions, optimizes its energy use through the use of renewable energy sources and other strategies, and develops waste management practices based on sustainable development principles (3).

- 3- Smart people: a society that learns. The people who live in the city should be the ones to start any changes because they are the ones who can prevent excessive energy consumption and pollution and work to improve their quality of life when given the right technical support.
- 4- Smart living: a welcoming atmosphere, particularly through the availability of extensive public service access, social and technological infrastructure, a high degree of security, a wide range of cultural and entertainment options, and appropriate maintenance of the environment and greenery (4).
- 5- Smart mobility: city develops into an enormous web connecting all of its resources. Modern technologies required for the efficient use of already-existing infrastructure should serve as the foundation for both digital communication and traditional transportation.
- 6- Smart government: development in this area necessitates the establishment of an appropriate system of governance, the creation of policies requiring the collaboration of local authorities and other city users, and the application of new technologies in city administration (5).

3-2 The contribution of smart cities elements:

An urban area that gathers data using various electronic techniques and sensors is called a smart city. The effectiveness of municipal operations, services, and citizen relations. Enhancing policy efficiency, cutting down on waste and inconvenience, raising the standard of social and economic conditions, and maximizing social inclusion are the primary objective of data is gathered from citizens, devices, buildings, and assets. Following that, the data is processed and examined; in order to build a relationship with residents and optimize the efficiency of city services and operations.

With the use of smart city technology, city officials can monitor and engage directly with the community and city infrastructure, lower costs and resource consumption, and improve communication between the public and government (6). The following figure 2; showing the core infrastructure elements of smart cities:



Fig. 2: Smart City – Elements, Features, Technology and Government Approach, By: Constro Facilitator, Year: 2021.

The foundation of the development of physical infrastructure is structural engineering. In addition to coordinating and working in tandem with various other disciplines to take their needs into account, practicing civil and structural engineers are involved in a wide range of activities and tasks, including the conception, selection, and development of structural systems appropriated, as well as preliminary sizing and design of structural components (7).

All of these multi-dimensional, intricate tasks call for sophisticated, effective, and demanding computing technologies. Currently, the primary method for applying engineering knowledge is automated computing. The application of computing tools and technologies has grown and developed incrementally and linearly, as have new paradigms (8).

4- Smart technical solutions in sustainable cities

Following the introduction of smart cities elements and dimensions; in part to the developments in modern technology, the long-awaited dream of a modern utopia that aims to strike a balance between cutting-edge technological interventions and traditional systems has finally come true. Technologies such as artificial intelligence (AI), machine learning (ML), deep learning (DL), cognitive computing, and big data analytics have played a major role in realizing this goal (9).

The goal is to transform every entity in a traditional city using contemporary technologies into an autonomous object that can function on its own without a lot of outside assistance. With the aid of smart devices, users can access automated daily processes such as governance, policies, services, and feedback from any location in the world. By using economical and environmentally friendly methods, automation has helped reduce environmental hazards to a reasonable extent (10).

4-1 Key-factors affecting smart building integration:

The globally unprecedented pattern of wealth, energy, and population growth that is causing a period of peak urbanization. Sustainability development aims to change people's lives, workplaces, and means of transportation through the use of knowledge-based strategies. The primary production technique in the development of smart cities is data-driven urbanism. In order to inspire smart cities to become sustainable and effective in the future, the aim is to analyse current trends and technologies using an information-driven approach. The Internet of Things (IoT) has developed into a crucial component of smart city amenities due to its enormous potential to improve sustainability as shown in the following figure 3. The use of back casting in sustainability research will grow in the future. In data-driven smart cities, big data and analytics aid utilities in achieving operational efficiency (11).

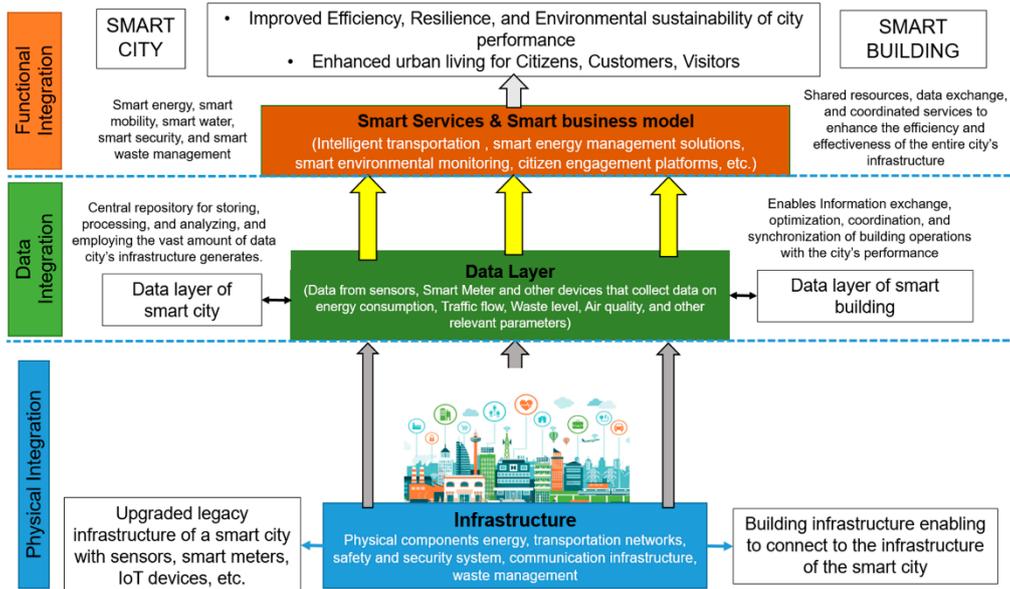


Fig. 3: Key-factors for smart integration, By: MDPI, Year: 2023.

The majority of the data transfer protocols created thus far for the Internet of Things are incompatible with one another. Further work is needed to make it possible for sensor nodes in the network to communicate with one another using various protocols while consuming minimal power, which is essential. The creation of low-power hardware and effective storage strategies, which can lower operating expenses. Decentralized systems have been suggested as the best ways to improve application reliability from a deployment standpoint (12).

4-2 Smart automated cities culture and community:

Towards more effectively leverage data-rich environments, this paper promotes sustainable

development from a cities-based perspective. This method acknowledges the crucial and integrative role that urban areas and urban living have in the advancement of sustainability. Cities are the hub of social, cultural, and economic activity because they represent the predominant form of spatial organization today (13).

As shown in the following figure 5; cities are complex arrangements of numerous interconnected systems, both automated technological system and social indicator, to put them in the best possible position to simultaneously address several sustainability goals. Additionally, cities provide more practical, quick, and grounded solutions to sustainability issues (14).



Fig. 4: Smart city of tomorrow, By: The Egis Group, Year: 2022.

4-3 Smart solutions benefits and impacts:

The smart cities grid is one of the most heavily influenced sectors of the economy by digitization. The application of technologies that have been successfully tested in big data and intellectualization processes to the future cities.

As a result, the following figure 4 shows the smart solutions criteria: the E-Governance and citizen services, the waste management, water management, energy management, urban mobility and other smart solutions.



Fig. 5: Info-graph shows smart solutions criteria, By: Stephen Lester, Year: 2016.

5- Noor city in Egypt as a leading smart city

Nowadays, real estate development companies in Egypt have been moving quickly in the last few years to embrace modern methods adopted by the "New Administrative Capital," which is a symbol of this transformation. These modern methods include building a robust infrastructure that can support all forms of modern technology, including artificial intelligence, the Internet of Things, renewable energy devices, smart applications, and other forms of technology, in addition to the administrative and regulatory framework that includes operating systems for waste management, traffic, and other areas.

Big data is also collected, managed, and analysed to help city administrations become more effective and responsive to the needs of the populace. This paper will examine an example for Real estate developer Talaat Mostafa Group (TMG) created Noor City, a small smart city in Egypt (15).

5-1 Noor-City smart solutions:

Over the duration of the project, there has been an increase in green space because Noor City covers an area of about 5,000 acres. By building a complex network of fibre optic cables, installing CCTV surveillance systems, using 24-hour monitoring and control rooms, and utilizing other cutting-edge modern technologies, the Noor City for (Hisham Talaat Moustafa) project will incorporate the idea of smart cities. As shown in the following figure 6; the result will be a sustainable futuristic city. (15).



Fig. 6: Noor-City by (TMG), Year: 2021

6-1 Smart lighting in cities:

The energy consumption of modern streetlights, which also contribute to urban light pollution by burning brightly when no one is around, has been a source of concern. These are only a handful of the issues that certain solution providers hope to resolve with their Smart Lighting offerings. They seek to, among other things, lower maintenance and

energy costs, increase city safety, improve lighting efficiency, and create multipurpose poles (16).

The solutions of lighting in Noor city as shown in the following figure 7; adopted in LED lights around the city; residential, commercial, streets, etc. 40-50% energy saving. Active dimming through CCTVs enabling further reduction of energy consumption by 15%-20% vs. LED only solution (15).

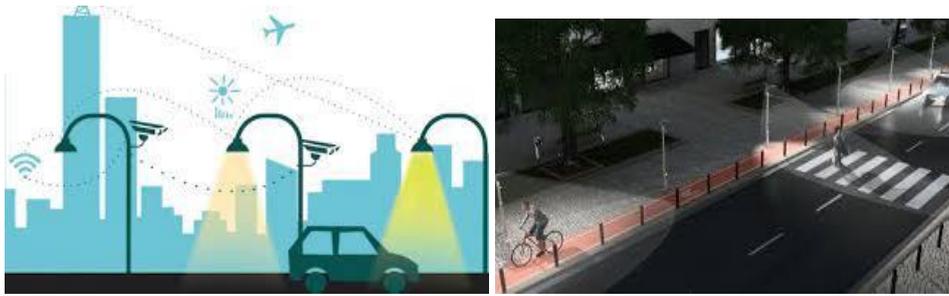


Fig. 7: Smart lighting solutions. By: TMG, Year 2021.

5-3 Smart public transportation:

Smart transportation is another crucial element of the Smart Digital City. Since in any transportation system the amount of data produced by vehicles, road infrastructure, and road mobility is all relatively large. Consequently, a unique module for smart transportation has been developed (17).

City traffic information is also gathered from the Noor city, via cars' IoT devices, for instance, the

location and speed of a car. The vehicular network and road sensors both gather data, as shown in the following figure 8; vehicle sensors gather position, velocity, and mobility information from the vehicular network. Road sensors gather information on average speed between intersections and traffic flow at each intersection (18).



Fig. 8: Smart public transportation network, By: TMG, Year 2021.

There are currently four benefits to be aware of as following:

- 1- EV Electric battery powers the bus.
- 2- 50% less fuel was spent when electricity was used.
- 3- 40–70% less expensive maintenance than on a diesel bus.
- 4- Live schedules are displayed on smart screens at bus stops.

5-4 Renewable solar energy:

Following the completion of analysis; TMG installs Smart Grid features to manage distributed PV panels and generates a portion of the required electricity from photovoltaic panels. panels mounted on commercial, residential, and public structures.

Positive image and ESG impact result from this. a grid that is more balanced and stable varied energy sources, less reliance on the grid, and less need to buy electricity



Fig. 9: Smart cities cycle, By: Ana Iolanda Vodă and Laura-Diana Radu. Year: 2018.

5-5 Smart city safety and security solutions:

The most crucial technological tools that supported the security system in smart cities were surveillance cameras to deter theft and intrusion, self-control units for elevators, and early warning systems to guard against natural and man-made disasters. Natural disasters are just one of the subgroups of

emergencies that may endanger cities and the people who live there.

Safe City as one of Smart City's subsystems, covering every facet of city safety. Among the many uses of smart technologies in the field of safety are the establishment of the Safe City system and the attainment of readiness and prompt

response to emergencies that pose a threat or arise. The following elements should be part of the Safe City system:

- Smart health care.
- Intelligent routes and traffic systems.
- Intelligent safety systems that facilitate early warning, monitoring, forecasting
- Decision-making through surveillance and crisis management.
- Environmental conditions and emergencies.
- Police units with central operations and the Integrated Rescue System (IRS) (19).

6- Smart Ubiquitous connectivity future cities

Nowadays, the goal of smart cities is to make future towns more efficient in terms of supply, transportation, waste management, security, and general quality of life. This chapter outlines the cutting-edge technologies that will underpin modern living. Cities of previously unheard-of sizes and densities have resulted from the considerable increase in urbanization. In the coming decades, there will probably be more megacities created, which will result in even higher population densities in urban areas definitions and challenges (20).

6-1 Future smart cities programme for sustainable development:

Based on previous; future smart cities will be essential to meeting citizens' ever-increasing demands. Improvements in communication and information technology will enable more effective resource management. The progress of the urban environment will ultimately determine the fate of global betterment. The rapid migration offers opportunities, but it also brings with it difficulties. The challenge facing governments around the world is how to create sustainable, reasonable space in the world's cities, which are growing every year. The smart city model is one in which the industry is active, citizens' rights and well-being are guaranteed, and urban planning is evaluated from an environmental perspective (21).

Thus, the following figure 10 presents the United Nations development program, the program is divided into five sections: creating an insights platform for smart cities, forming a community of practice, sharing knowledge, and developing expertise in smart city delivery.

all these services are provided both locally and remotely, as well as through collaboration with global partners.

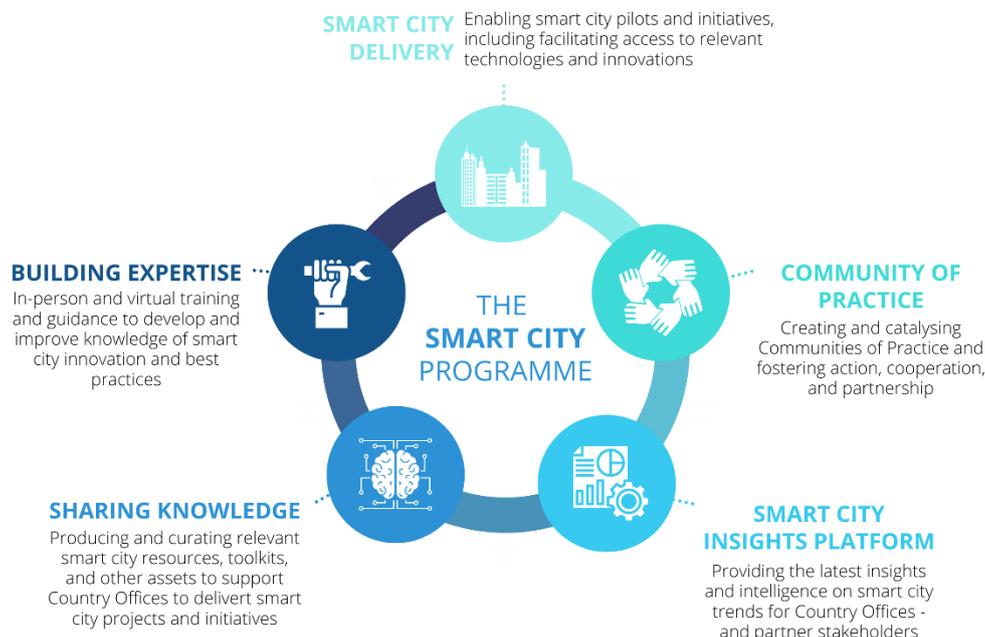


Fig. 10: Smart city programme, By: United Nations Development Programme (UNDP), Year: 2023.

Furthermore, the Future urban settlements will require a complete and fundamental change in how technology and innovation are used in urban settings; these include smart city governance, data management and analysis, digital infrastructure, funding, and creative partnerships (22).

6-2 Smart cities mission and goals:

Based on previous; global development framework concentrated on the 5Ps: People, Planet, Prosperity, Peace, and Partnership. Smart solutions are applications that improve municipal infrastructure

and services including controlled distribution valves, real-time online data, monitoring systems and intelligent video surveillance networks throughout the city (23).

In order to encourage understanding among individuals and provide a foundation for future conversations about the goal of smart sustainable cities, the impact that human activity has on ecological systems around the globe and that urbanization is a result of people relocating to cities, sustainable development is still primarily

considered technological progress; while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental as well as cultural aspects (24).

The sustainability, economic, and liveability pillars are the main goals of creating smart cities; throughout the nation urban mission that is fully in line with worldwide agendas and gives cities the authority to spearhead sustainable development. It provides important insights for urban regions in the Global South and acts as a living laboratory for people-centric smart urbanization (25).

7- Conclusions:

This paper presents a frame-work of technical solutions in smart cities; the smart economy, smart people, smart participation in decisions, smart transportation, smart environment, smart life that cares about health conditions and individual safety" are the fundamental components of this type of city; In addition to connecting smart devices to one another through networks, communication technologies, and remote sensing equipment, it also emphasizes offering innovative solutions to any problems that a person may encounter. It also advocates for the use of new and renewable energy sources to protect the environment, as well as the practice of creative and cognitive activities. Egypt is now using technical solutions and contemporary technology to build smarter, more sustainable new cities.

Applying various technical solutions leads to the future road and city maps will be revised, changing the conventional perception. Keeping cities safe, healthy, and able to accommodate the diverse and expanding needs of their citizens is one of the challenges that come with living in a city. To do this, more electric energy, and hydrogen fuel for small cars, as well as the use of traffic congestion prediction systems, may be introduced in the future. And build new sustainable cities in the future by utilizing contemporary technologies.

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