International Journal in IT & Engineering (IJITE)
Volume 7 Issue 12, December 2019 ISSN: 2321-1776 Impact Factor: 6.493
Journal Homepage: http://ijmr.net.in, Email: irjmss@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal

SMART CITIES: FROM THE PERSPECTIVE OF URBAN PLANNING AND DESIGNING OF BUILDINGS

Abdulrahman Majrashi[1]

[1]Assistant Prof. of Architecture and Urban Planning, Islamic Architecture Department, Faculty of Engineering and Islamic Architecture, Umm Al-Qura University

Mohamed Osama Khozium[2]

[2]Professor, Department of Engineering & Applied Science - Computers, MCC Umm Al-Qura University, Makkah Al-Mukarramah, Saudi Arabia

Abstract

There is a common concept that comes to mind when talking about smart cities, where some believe that the concept of smart city is limited to the existence of a digital infrastructure that enables the use of information technology and confined to smart phones and applications or the provision of Internet (WiFi) in public places, however the truth is that the intelligence of cities goes far beyond that, since it is smart cities that enhance the lives of their inhabitants to become easier and more productive and with techniques that ensure the sustainability of urbanism, economy, environment and society.

In the construction sector, urban design standards had to be revisited, and this is what the research tries to raise because this aspect is still not fully implemented in some of our local designs, where the research proposes some new standards to design buildings to fit the concept of smart cities.

Keywords Urbanization, Governance, Technical foundation, Smart building

1. INTRODUCTION

The success of urban development depends on the existence of large-scale projects that have the potential to make a positive and sound transformation to address existing development issues or provide new development opportunities for the city and its inhabitants, and usually the optimal urban development process is initiated by generating an urban idea adopted by decision makers in the management of the city , there are many development ideas in the world that have turned into projects with a different development dimension and left a dazzling impact on their results after implementation, despite their presence in cities not in the ranks of the world's major cities, and perhaps most notably the comprehensive cable car transport project in Medellin, Colombia, which was The problem was that the residents of the slums in the hills were cut off from the city because they lacked easy access to jobs, education and other services. The idea of the project of the first air cable system in the world is fully integrated into public transport where the system rises over the densely packed and dangerous streets, It connects the hills to the city center, which brought about a paradigm

shift after its execution as crime levels dropped dramatically and accessibility levels improved between different parts of the city.

On the other hand, there are bold ideas in urban development, the most recent of which is the construction of an outstanding suburb (Cosmo Park) in Jakarta by an urban development company in Indonesia, which is a recreational residential village, which is a beautiful mixed-use oasis built on a 10-storey shopping center. [1] Therefore, we are urgently needed to explore specific and innovative ideas and projects for urban development that respond to the different development issues and problems in our cities to help develop cities and solve their difficult problems so that they have a sustainable impact in the future development process.[15], [16].
In this research we have listed some new standards that will develop cities and solve their problems. The research was divided into five sections
Introduction is this section, in the second section we talked about the concept and foundations of smart cities, the third section was on urban development basics and principles : smart building approach, then in the fourth section was a proposal for new standards for the urban development of buildings, in the fifth was the conclusion .

2. THE CONCEPT AND FOUNDATIONS OF SMART CITIES

Smart cities are an emerging trend among policymakers around the world. The majority of the world's population today lives in cities, and for this understanding and application of smart city concepts is indispensable to ensure a distinct standard of living for the population. Creative thinking and cooperation among all stakeholders, Scientific ideas can bring the desired benefits to cities including the ability to efficiently and effectively absorb the large boom in the population, promote economic growth, and improve the welfare of the city's population. However, there is no standard definition of a smart city. Smart city projects are usually part of a general program of city modernization that includes urban planning, environment and information technology. The term 'smart city' appeared at the European Digital Conference in 1994, and in 1996 the Europeans launched the Digital City project in a number of cities. Amsterdam was adopted by the European authorities as a digital city, followed by Helsinki. [2], [15], [16].

Smart City Definitions

Encyclopedias and technological research and studies centers define Smart City as a Knowledge City, Digital City or Eco City whose services rely on ICT infrastructure, such as automated intelligent traffic systems, advanced security management services, building management systems, automation in offices and homes and the use of billing meters. The Wikipedia encyclopedia explains the term spatial intelligence for cities as referring to information and cognitive processes, collective intelligence, and collaborative problem-solving. The concept also refers to the increased prevalence and use of ICTs and the institutional environment for access to science, innovations and physical infrastructure of cities to increase the ability to solve community problems [2].
Smart cities were defined by the EU as those which bring the citizens, the city and the industry together for the urban life improvement by having more integral and sustainable solutions, which include better planning, applied innovations and intelligent use of ICTs. It can thus be defined as a city that performs well in all these areas through a common

interaction between the economic sector, governance, transport, environment and life with conscious and independent citizens. [3] In terms of urban planning terms, smart cities go far beyond what most people might realize, Rick Robinson, an executive engineer at smart cities group IBM Europe, believes that smart city systematically seeks to create and encourage innovations in technology-enabled city systems, changing the relationships between creating economic and social value and resource consumption. It thus contributes in a coherent manner to the achievement of a clear vision and goals supported by the consensus among the city's shareholders [3] At the First Annual International Summit on Smart Cities in North Africa, held at Al Akhawayn University in Bio, 2014, organizers developed a scientific definition of smart cities by covering four themes Namely urbanization, digital containment, governance, transport [2], [15].

There is also a theoretical concept developed by Kraj Liwaite at the University of Amsterdam 2011 which said that a city can be smartened when the exploitation in individuals and social capital and the infrastructure of conventional communication ways (transport) and new (ICTs) contribute to an economic development that can be sustained. In creating a life of a high quality, all along with a reasonable natural resources management through commitment, participation and teamwork management [3] . There are those who considered that the term smart city is called regional systems with creative levels that combine knowledge-based activities and institutions to develop education and creativity, and digital spaces that develop interaction and communication, to increase the ability to solve problems in the city. [4] , [16].

Valery Schafer, CEO of Beacon Recycling, said the Smart City is one which uses communication, ICT and information for improving the performance such as in the usage of water, the electricity, the parking, the waste management and the traffic.

Cities provide modern methods for the management of complexity, reducing costs, increasing efficiencies and improving the life quality.

Data are being collected and analysed by smart cities as well as the information which are both being used for the improvement of the infrastructure, wise investment and to facilitate the lives of their populations. [5] There are those who considered the smart city is a city that has an advanced system based on infrastructure based on digital communication and information technology to monitor and follow up its parts, components, inhabitants and infrastructure services and equipment, road networks, railways, tunnels, airports, ports, economic and industrial facilities, buildings and real estate, and a network of connections and resources such as water, electric power, gas and vehicle fuel [6]. Beyond technological terms and details, the concept of a smart city has significant implications for human life, and its critical implications are directly related to its food, drink, work, and other living conditions. [7]

The intelligence of the city was associated with its sustainability, where smart City is a city that takes into account the requirements of sustainable development. In June 2013, HENRICH BOLL published a book entitled “Smart Growth, the Green Revolution”. The main hypothesis of this study is that only smart growth is sustainable growth. One of the most important criteria for intelligent growth is the transformation of energy production and consumption systems to operate more efficiently [8]. Over the years, new concepts and ideas for sustainable energy have emerged that should be part of the future of any city. From a clean energy perspective, smart cities can mean sustainable cities but require a lot of work and planning. Some researchers have defined the real smart city as an urban gathering with three basic elements: a technical foundation, a social foundation, an environmental foundation, and it can be said to be three cities in one, the virtual city of information, the city of knowledge, the environmental city, a place where virtual and realistic meet [9], [2], [4].

3. URBAN DEVELOPMENT BASICS AND PRINCIPLES : SMART BUILDING APPROACH

The concept of smart buildings emerged in the late twentieth century and are buildings that respond to the requirements of effective users with the external environment and all services are managed by digital systems and contain high levels of technology, i.e.: The ability to program the building electronically with a range of possible possibilities that enable its various components to adapt and act according to the corresponding conditions and variables known.

A. The smart building is characterized by the following:

- The building must know what is going on inside and outside.
- The building must decide the most efficient way to achieve a suitable and productive environment for users.
- The building must respond to the demands of users.

B. How Smart Buildings Work [10]

Buildings use technologies based on the use of microprocessors in control systems, it incorporates energy efficient technology by controlling air conditioning, lighting, heating and cooling using the Automation Touch Screen as shown in figure 1. Energy can also be controlled through the use of Sensors at strategic points that continuously feed information into the system that lights or extinguishes electricity once occupants enter or exit the building, thereby significantly reducing energy consumption.

Figure 1 Automation Touch Screen

C. Intelligent building system consists of:

- Purposive Systems: such as lighting, air conditioning, water supply, sanitation, security, television and telephone connections, etc.
- Structure System: This includes the materials and method of creating the building.
- Intelligent System: Figure 2 shows the intelligent building of this system which acts as the mind controlling the rest of the systems, which makes each system change its behavior in proportion to changes in other systems, and this system is the mind governing the rest of the systems.

Figure 2 Intelligent Building

D. Intelligent System

Its goal:

Electronic control of property to support self-response to environmental variables and meet the wishes of users without the need for direct humanitarian intervention

Benefits:

Energy efficiency and reduced pressure on non-renewable natural energy resources towards sustainability Flexibility of change and physiological comfort and reduce the operational cost of the building Provide maximum comfort and safety to users and a healthy environment. And easier control for the average user with the possibility of control of home systems through smart devices, whether from inside or outside the home (interactive viewing) protecting the house against thefts as smart homes will modify human behavior, it can be said that the city will be safer.

Functions- Temperature and humidity control: Intelligent interior space conditioning systems with automatic start and stop capabilities according to a specific schedule or remote control or by linking them to sensors that measure optimal performance variables.

- Ventilation, lighting and sound control: intelligent systems for spaces and equipment housing where the smart choice of sites and spaces openings and control so that the role of ventilation and natural lighting can be activated through smart blinds.- Access control of the house: systems to control the entrances of the house and parking of vehicles remotely.

- Energy, water and gas control: intelligent systems to control electrical energy and lighting within the best performance standards and improve energy consumption, water supply, sewage and waste.

Control of alarm systems: to monitor and protect resident's public property, fire protection, monitoring, surveillance and security applications.

E. Smart building materials

Materials that are able to feel and respond to the surrounding environment in the required and pre-determined manner so that they can change their physical properties instantaneously in response to natural or artificial catalysts.

Smart materials are characterized by the following:

- Immediacy: where they respond at the same moment.

- Transiency: being responsive to more than one environmental situation.

- Self - actuation: the fact that the intelligence in these materials internal and not externally.

- Selectivity: their response is distinct and predictable.

-Directness: The response is localized to the trigger event.

Smart materials in the building appear in several elements Figure3, figure 4.

- Structure: slabs - columns

- Outer shell: external walls - external packaging.

- Finishes: ceilings - floors - internal packaging.

Figure 3 ETFE Tetrafluoroethylene Ethylene

Figure 4 Translucent (Transparent) concrete [13]

Similar examples The Bibliotheca Alexandrina building project shown in figure 5 is the first to be intelligent in the Middle East. Technology was instrumental in the formation of external masses that expressed its design and symbolic idea. The structural elements were concealed to direct importance towards the symbolism of the sun disk as a basic external mass and dominate the overall design. As well as the choice of modern building materials for the ceiling of steel metal and glass panels that reflect light to the interior space without direct access to the books to achieve the desired functionality, as well as the expression of the transparency of the walls by cutting aluminum and glass to allow the entry of appropriate light

Figure 5 Alexandria Library Between architectural splendor and intellectual significance [12]

Figure 6 Shanghai Armoury Tower [14]

The main structural structure of the building seen in figure 6 is designed to allow for future changes and supports the flexibility of the outer shell of the smart interactive membranes as well as smart interactive walls capable of self-sensing environmental changes. Reduce operating costs throughout the life of the building through the use of intelligent technology equipment - remote control unit with a visual signal to control the spaces by occupants by sending television signals from the user to control devices to ignite and extinguish industrial lighting automatic control of solar breakers which moves according to the sun's angles and wind guides.

Heliotrope Tour Tower

Figure 7 shows the miter which is a cylindrical structure that has one side of the glass divided into three levels to take advantage of light and heat. The other side is thermally insulated to keep cool in summer times which use a system to filter rain water automatically, collected and reused. The design of the building is based on the concept of "sunflower plant", a house that is based on a movable base that rotates at different hours of the day to face the sun on winter days or counter during the summer, depending on the needs of the inhabitant.

- There is a large computerized solar panel, modules or panels on its surface that are used to collect solar heat to produce energy, heating water and heating, which means less electricity consumption.

Figure 7 Heliotrope Tour Designed by Solar Architektur Rolf Disch [11]

4. PROPOSED SMART BUILDING DESIGN STANDARDS

According to previous studies, and as previously mentioned in this paper, it is now clear that urban planning for smart buildings is considered to be the key factor for a successful smart city and has a direct effect on it. However, there was no sufficient attention given to this crucial factor, and accordingly, there has to be some standards and principles to follow that suit these technological advances.

And from this paper we concluded some standards and principles that fit with these modern requirements.

A. Firstly

• Re-linking urban dwellers with nature:

- Simulation of nature within the dense urbanization of cities.
- Use balconies with hanging gardens to bring nature to the floors of tall buildings.

B. Second:

The openness of buildings to their surroundings in particular and to the city in general:
Achieving the openness of the ground floor and integrating it with the surrounding public space and finding ways to attract the goers.

C. Third:

- To reduce the isolation of residents of tall buildings from each other and the city:
- Continuity of the extension of public space vertically on the buildings of the city
- The use of public spaces to meet the population and practice joint activities among themselves inside buildings.
- Connecting the internal spaces to the outer space.

- Achieve the widest view of the internal spaces on the outside. Fourth: Taking into account the requirements of the owner and the building systems and the architecture of the project area and climate and the view of the project and the shape of the site

Deepening and extending the project program studies to include all project requirements over the long term (50 years).

D. Fifth:

Absorption of buildings for future change and development:

- Achieving flexibility in the design of the general site and projected buildings
- Design of the structural structure on the outer perimeter of the projected buildings.
- Evacuating the interior spaces from services and placing them outside the activity areas.

E. Sixth:

Raising the residential density in one building to achieve the vitality of the various economic activities and reduce the extension of cities:

- Increase building heights.
- Diversification of activities.

F. Seventh

- The application of the principles of sustainability in a way that is not isolated from the architectural design:
- The application of environmental design standards through the use of ventilation and natural lighting and ventilation (passive systems) to reduce energy consumption and reduce carbon emissions, so that the designer absorbed within the main architectural design idea.
- Facades are also a design element, but as an outer shell that protects the building from external natural factors, which must be taken into account when designing.

G. Eighth

- Achieving the human scale of buildings and avoiding huge blocks within city centers:
- Permeability of pedestrian movement and means to reduce the size of blocks and increase the number of roads and corridors within the neighborhood.
- The permeability of natural lighting and ventilation to buildings by reducing the size of the building block compared to the area of facades.
- Permeability of vision from and on the building.

H. Ninth

- The use of modern technologies to solve the problems of cities:
- Such as the use of automatic lifts inside the parking lots to increase their capacity within the centers of cities where the scarcity of parking.
- Like the use of high-speed elevators to achieve a stronger correlation between the roles of high buildings.

5- CONCLUSION

In this paper, we show that smart cities are more than just having a digital infrastructure or being confined to smart phones and the constant availability of Wi-Fi. This misconception has been corrected in this paper by proving that smart cities aim for improving and enhancing the life of their residents to become a much easier and a more productive life, and thus, being smart doesn't necessarily have to be related to Wi-Fi and ICT, in fact, there are many ideas that have turned into projects with a smart development leaving an amazing impact despite their presence in normal cities, not major ones.

A very big part of the success of smart cities relies on the smart buildings which use technologies that are based on using microprocessors in the control system that makes it very accurate and efficient in responding to the users' demands. And since the core of sustaining a smart city is by having urban planning and designing for the buildings, these plans should follow the right principles and standards that have been mentioned such as relinking urban dwellers with nature, the openness of buildings to their surroundings in particular and to the city in general, making buildings ready for future change and developments and raising the residential density in one building to achieve the vitality of the multiple economic activities and to decrease the extension of the cities.

The intelligence of a city is associated with its sustainability, and this requires a lot of work and planning, and following the basics, principles and standards as those have been mentioned in this paper to reach the optimal goal.

REFERENCES

[1] Al-Saleh Fahd; " Ideal development of cities ",AL Riyadh, August,2019.

[2] Al Nahas Hanan, "Smart Cities: A Study of Concept and Foundations", Maroclaw, July, 2018.

[3] Vargas Maritsa; "smart-cities-dream-or-reality " , envirocitiesmag, environmental center of arab cities, Issue 8 May 2014.

[4] khuloud sadek, Safour M., "Smart cities and their role in finding solutions to urban problems, case study, transportation problems in Damascus city" Damascus University Journal for Engineering Sciences, Volume 29, Issue 2, 2013.

[5] Valerie Schafer, Smart Cities, Recycling, Integrating Smartphone Technology with Smart Recycling Bins to Accelerate Recycling Efforts, Environment Cities Magazine, Sustainable Smart Cities, No. 8, 2014, p. 18.

[6] Abdullah Mohammed Al-Aqeel, Smart Cities and Buildings, Science and Technology Magazine, Smart City, Issue, 111, 2014, p. 4

[7] Shadia Ahmed, Smart City, Green Future City, Future Horizons, Science and Technology Magazine, Issue April May 2014, 22, p. 91.

[8] Alice Koman, Are Smart Cities Sustainable Cities, Environment Cities Magazine, Smart Sustainable Cities About the Environment Center for Arab Cities, Issue 8, May 2014, p. 14.

[9] Abdulqader Bin Abdullah Al-Fintoukh, Smart Cities Initiative in Saudi Arabia, Arab City Magazine, Issue 168, July. August-September, 2015, p. 59.

[10] Al-Baaj Alwaleed, "Physical Globalization and Housing Projects A comparative analysis in Iraq", Smart cities conference, University of Basrah, Nov., 2017.

[11] Rolf Disch, Solar Architektur, http://www.rolfdisch.de/en/architects-office/ Last visit Dec., 2019.

[12] All about building, Alexandria Library Between architectural splendor and intellectual significance, Art to live gallery, https://www.allabout-building.com/ Last visit, Dec., 2019.

[13] Qasim Muhamad Shakir;" Translucent(Transparent) concrete" Faculty of engineering , KUFA university, Jan., 2017

[14] "Shanghai Tower Breaks Ground". Luxist.com. 29 November 2008.

[15] Norah Farooqi; Adnan Gutub and Mohamed Osama Khozium, "Smart Community Challenges : Enabling IoT/M2M Technology Case Study" Life Science Journal, 16(7), July, 2019.

[16] Ali Mohammed Al-Sharey; Reem Alshalawi and Mohamed Osama Khozium, "Smart Cities : Integration of GPS and IoT Approach" MULTI-K NOWLEDGE Comprehensive Journal For Education And Science Publications (MECSJ), ISSUE (18), Apr.,2019.