The Future of the City: Towards Establishing Intelligent Cities

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Abstract Technologies become more relevant nowadays in order to deliver different results and more meaningful to its residents. A smart city is an urban area that can use multi sorts of sensors and electronic means to collect its data for delivering the results needed to develop the quality of the life. When the city becomes smarter, it will be more responsive and more livable for its residents which effect on the quality of the urban design in many dimensions: as health, environmental quality, conveniency of the time, safety, the living's cost, and civic participation. Although that there is many information about the technology and its capacities, but there is a lack of information in terms of how to start, design and secure the smart city, therefore the Smart cities will be in risk if there is limited understanding in the implementation phase, and it will become vulnerable systems in the future. The research aims to study smart cities prospects and how technology is resolving confronts for better anticipate the future to make cites inclusive, secure, resilient and sustainable. To achieve these goals, the research will depend on the analytical application methodology, and it will focus on the characteristics of smart cities, and the ways to find relationship between people who are familiarity with the technology to improve the different life aspects. The findings contribute to develop the quality of the life and to acquaintance and practice by assisting smart solutions, underlying its role in sustainability development for the smart cities.

Keywords Smart city · Intelligent city · Quality of life · Information · Communication technology

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1 Introduction

When the United States Community Analysis Bureau employed records, aerial photography, and cluster inquiry to gather data, report issues, and allocate resources to direct services, minimize ruins, and decrease poverty, the smart city was born. A smart city employs information and communication technology (ICT) to increase operational efficiency, exchange information with the public, and deliver improved governmental life quality and service for the good of its citizens.

In the many sectors of urban systems, the environment and economics, the range of smart city application fields is very broad. The provision of real-time information regarding smart city components is critical for the operation of various useful apps and services, as well as for improving smart city performance and citizens' quality of life in the direction of a sustainable environment (Abou El Seoud 2019).

2 Methods of Research

2.1 Aim of Research

Smart cities should stipulate: an urban environment that provides citizens with a good quality of life while moreover producing economic progression. This is especially crucial in view of future urban population increase, which will necessitate more effective use of infrastructure and assets. Citizens will enjoy an improved quality of life as a result of this. The research aims to: highlight smart cities prospects, determine how technology is resolving confronts for better anticipate the future, provide an intellectual approach on how to establish a smart city towards better quality of life, make cites inclusive, resilient and sustainable.

The study explores the following questions:

- What are the benefits of smart cities?
- What are the implications of applying smart city approach?
- The possibility of benefiting from technology to better quality of life.

2.2 Methodology of Research

The research followed analytical application methodology.

It is divided into three main parts:

First part: theoretical part focuses on the characteristics of smart cities, and the ways to find relationship between people who are familiarity with the technology to improve the different life aspects, investigate smart city possibilities and how technology is addressing challenges.

Second part: global case studies were introduced and used to get lessons, focus on the characteristics of smart cities.
The third part: the research deducted and suggests a 3-d intellectual model, focuses on improving, practice by assisting smart solutions, underlying its role in sustainability development for the smart cities.

3 Definition of Smart City

A smart city retains information and communication technology (ICT) to increase operating effectiveness, sharing within the public all data, and develop government service and citizen welfare (https://www.twi-global.com/technical-knowledge/faqs/what-is-a-smart-city).

A smart city, is defined as: "a place where traditional networks and services are made more efficient via the use of digital and communications technologies for the benefit of its citizens and businesses," according to the European Commission.

Smart cities employ—Internet of Things "IoT" to collect real-time data in order to better understand how demand patterns are changing and respond with more efficient and cost-effective solutions. According to IoT trends, the number of linked devices globally will reach 75 billion by 2025 (Harmon et al. 2015). The growing number of interconnected things creates a massive amount of data that the city can evaluate locally to make better decisions about what modifications or new initiatives would benefit citizens the most (Fig. 1).

Smart cities can also be defined as cities that rely on electronic technologies developed during the information technology era, beginning with the digital city and progressing through the electronic city, virtual city, and finally knowledge city, given that knowledge is the most comprehensive framework for data and information (Al-Qadi et al. 2018).

A smart city is one that makes usage of information and communication technologies to enhance people's lives, in order to compete, cities must improve all elements of their operations and services (Toli et al.2020). These benefits should be represented in satisfying the economic, social, environmental, and cultural requirements of current and future generations (Lacinák et al. 2017). It has a number of benefits, which vary according on the technology utilized, the level of integration, the data collected, and how this data is used to offer the information needed to make the best decisions (Narh, 2018).

4 Importance of Smart City

The primary goal of a smart city is to improve city functions and stimulate economic growth while also improving people's quality of life through the use of smart tech-

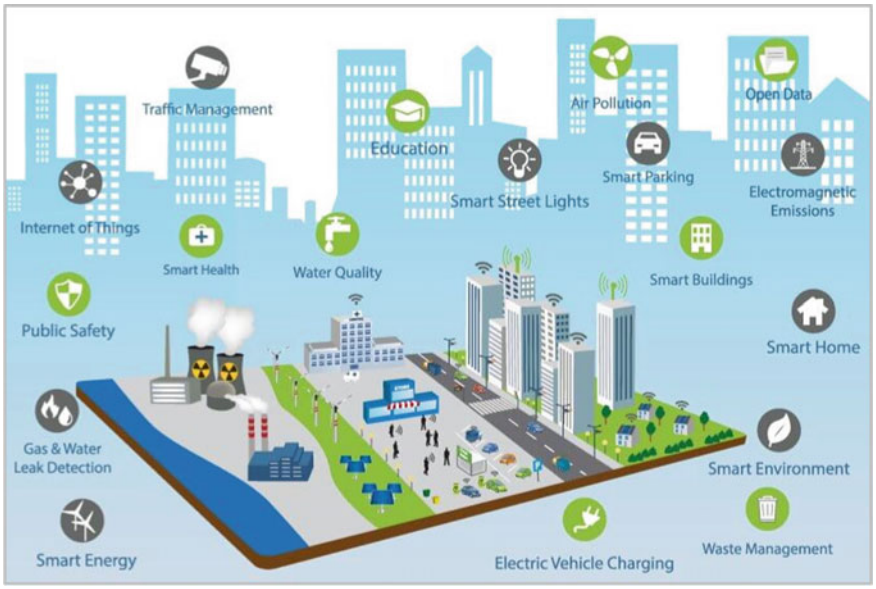

Fig. 1 Internet of Things (IoT) applications in the city (https://www.scnsoft.com/blog/iot-for-smart-city-use-cases-approaches-outcomes)

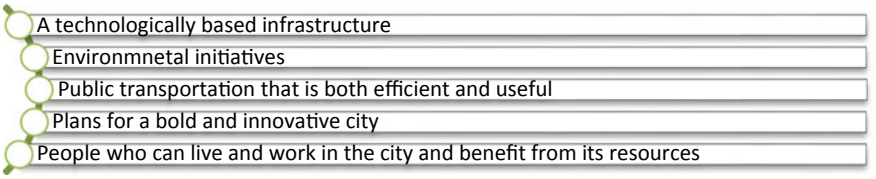

Fig. 2 Importance of smart city (https://www.twi-global.com/technical-knowledge/faqs/what-is-a-smart-city)

nologies and data analysis (Fig. 2). The value of technology is determined by how it is used rather than how much technology is available.

4.1 Aims of Smart Cities

- Improving the population's quality of life and delivering the greatest available services, whether in the areas of transportation, communications, the environment, information technology, or education.
- Governments must take full responsibility for turning this experiment into a genuine life model capable of lowering crises through the use of contemporary technology systems, in collaboration with city people and their cooperation.

- Massive population growth and significant pollution levels.

4.2 Challenges of Smart Cities

While the work of creating and maintaining a data-driven environment is outside the purview of local governments, the success of a smart city is dependent on collaboration between the public and commercial sectors. Furthermore, data analysts must assess the data generated by smart city technologies in order to discover any problems and make improvements (https://www.twi-global.com/technical-knowledge/faqs/what-is-a-smart-city).

Government officials enabling widespread civilian participation is one of the challenges to overcome. Residents must also collaborate with the private and public sectors so that everyone may contribute positively to the community.

5 How Smart Cities Work

In four steps, smart cities leverage a network of connected IoT devices and other technology to improve people's lives and spur economic growth (Fig. 3).

5.1 Smart Cities and Sustainability

The smart city concept is to use ICT to improve citizens' quality of life by improving city performance and increasing the city's level of sustainability (Ghonimi, 2021). The smart notion can be used to any form of sustainable city effort that aims to help the city achieve its long-term goals while also improving quality of life (Abou el Seoud 2019).

As smart cities strive to increase efficiencies in metropolitan areas and promote human wellbeing, sustainability is an important consideration. Cities have a number

Fig. 3 Characteristics of smart city. https://www.twi-global.com/technical-knowledge/faqs/what-is-a-smart-city

of environmental benefits, as smaller geographic footprints, but they also have certain drawbacks, such as the usage of fossil fuels to power them (Repko et al. 2012). One of important Smart solutions; the development of an electric transportation system to cut emissions, could help mitigate these detrimental effects. Developing sustainable solutions has the potential to help both the environment and society (Kumar, 2018).

6 International Case Studies

Cities all across the world are developing and deploying smart technology at various stages. However, there are a few who are ahead with this experience and are paving the way for truly smart cities (https://www.asme.org/topics-resources/content/top-10-growing-smart-cities).

This paper will present two international case studies: Singapore and Atlanta, the analysis of each case study will include: General city overview, Smart Nation vision, aims, and how to achieve this vision, and it will end with the advantages of each case to be as lessons learned in order to find the solutions to help sustainable development and to make smart cities successful to improve the quality of the life.

6.1 Case Study 1: Singapore, Republic of Singapore (Table 1)

Singapore has adopted a number of smart city initiatives, including the deployment of an autonomous fleet to assist the elderly and people with limited mobility (https://sustainabilitymag.com/top10/top-10-smart-cities-around-the-world).

According to the Smart Cities Index published by the International Institute for Management Development in Switzerland and the Singapore University of Technology and Design, Singapore is one of the most prominent countries that rely on modern technology to manage its affairs, making it the world's smartest city.

6.2 Case Study 2: Atlanta (Table 2)

The city's 'One Atlanta' policy aims to bring all of Atlanta's people together under one roof of 'accessibility to opportunity.' The endeavors are unfolded by the context provided ahead of time. Connecting Everyone, Street Lighting as a Data Hub, Access to Low-Cost, Clean Energy for All, and Affordable Housing (https://smartcity.press/equitable-smart-city-atlanta/).

Table 1 Case study 1. Singapore

General city overview	Singapore, called "Lion City," is one of the world's most densely inhabited autonomous countries. It boasts a multicultural population and a distinct cultural identity		
Smart Nation vision	As a response to growing urban challenges including ageing populations, urban density, and energy sustainability, it aims to use ICT, networks, and data to improve living conditions, expand possibilities, and build communities		
Aims	By fully utilizing technology, make the country the world's first smart nation; improve the country's quality of life; enhance enterprises; and create more opportunities (Lee et al. 2016)		
How to achieve this vision	Many international stakeholders, such as technology developers and entrepreneurs, are welcome to engage in this concept of using the country as a "living lab" to test novel ideas and smart solutions with global potential		
Advantages	Singapore has a well-structured basis on which to build its smart nation, thanks to its well-known infrastructure, technical innovation, and high-quality human resources. The smart services that are introduced are meant to be advanced and targeted at specific groups of people (Fig. 4 shows architecture character of the city and Fig. 5 shows smart applications strategy)		
	Most advanced smart services: the development of ITS has been going on for more than ten years in the transportation and urban mobility sectors	– Characteristics of smart nation: as a method of integration, it is necessary to develop an integrated data exchange platform among various government institutions	Needs to: create a platform for sharing data that allows all agencies to access data obtained from a common smart sensor network. Variations in data sensitivity are quite dangerous

Fig. 4 Architecture character in the city of Singapore. https://smartcitiesconnect.org/why-singapore-is-the-smart-city-of-2018/

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Table 1 (continued)

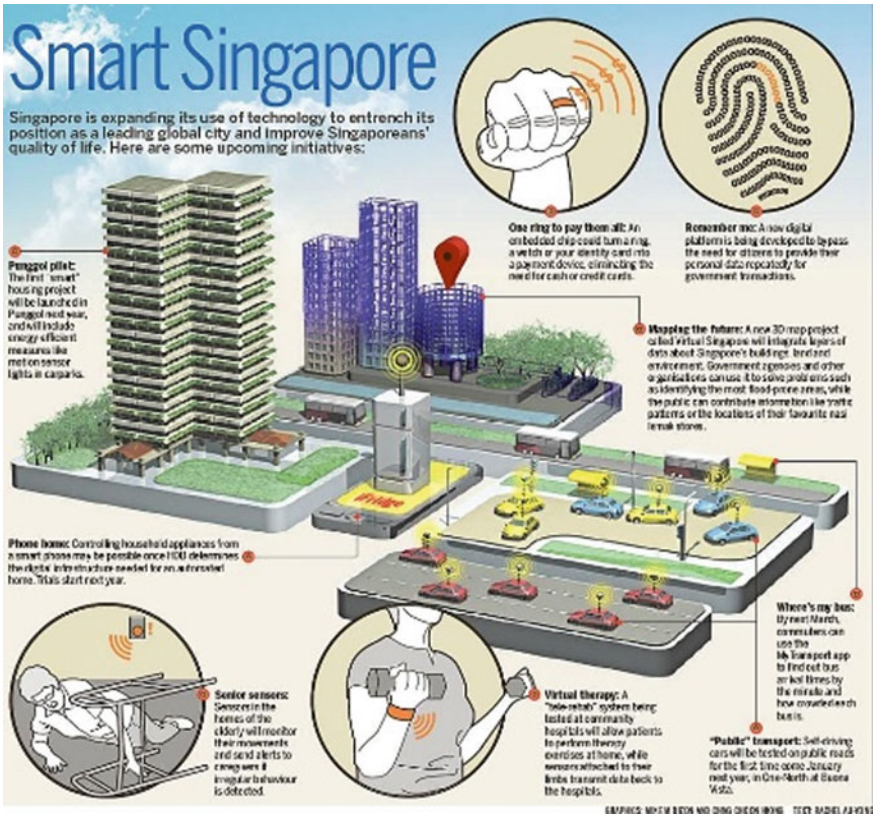

Fig. 5 Smart applications in Singapore city. (https://gregathanasius.blogspot.com/2015/01/2015-singapore-smart-nation.html)

The country set out on a mission to bring about E3A: everyone. Everywhere, all of the time

7 Towards Establishing Intelligent Cities

There is a shortage of knowledge about how to begin a smart city project. And while there is a lot of information on the technologies and their capabilities, there isn't much in the way of a defined beginning, middle, or end, and even less on how to secure each point along the route.

The study suggested three-dimensional intellectual sustainable approach, that can be employed to construct a smart city: Begin a smart city project with the use of technology and its possibilities, and secure each step along the way (Fig. 8).

Table 2 Case study 2. Atlanta

General city overview	The North avenue smart corridor, a 2.3-mile project that runs from Georgia Tech's Northside drive to freedom Parkway just past Ponce City Market, was presented as Atlanta's first smart city transportation project in 2017		
Smart Nation vision	The city is implementing smart city technologies, which are drawing international interest. Three recent developments are the North Avenue Smart Corridor, the city's huge camera network, and the first biometric terminal at a U.S. airport (Johnston 2019)		
Aims	The five main pillars on which Atlanta has decided to focus its Smart City efforts are multi-mode mobility, public safety, the environment, city operations efficiency, and citizen/business participation. Goals/Objectives: city services, public safety, and public services at a lower cost have all improved		
How to achieve this vision	Atlanta's Smart City strategic infrastructure initiative. A $250 million infrastructure bond is being used to fund a number of Smart City infrastructure projects throughout the city. As a result of these projects, the city anticipates cost savings, improved public services, increased public safety, and communications networks that meet the demands of residents and visitors (Fig. 6 shows architecture character of the city and Fig. 7 shows smart applications strategy)		
Advantages	Most developed smart services: adaptive traffic signals analyze traffic congestion in real time and adjust traffic light timing to move cars more effectively. Surveillance cameras allow traffic lights to be modified in reaction to persons crossing the roadway. A travel safely app provides aural alerts of potential threats by connecting to junctions, school beacons, and roadway users	– Characteristics of smart nation: Atlanta's Smart City strategy is built on a vast network of closed-circuit television (CCTV) cameras that are used for smart transit, crime prevention, and public safety	Needs to: Atlanta's operation shield program includes a citywide network of surveillance cameras and license plate scanners, as well as a predictive policing platform and criminal analytics software, "a network of innovative technology that create more efficient police

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Table 2 (continued)

Fig. 6 Architecture character in the city of Atlanta. https://atlanta.curbed.com/maps/map-midtown-atlanta-development-apartment-condo-office

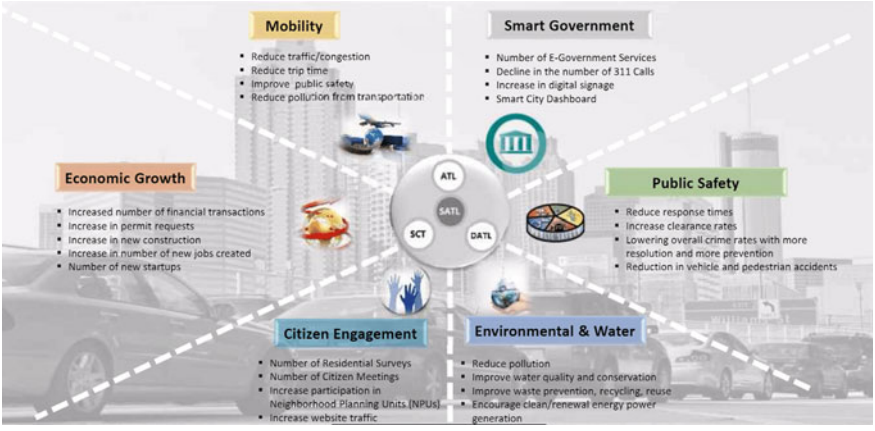

Fig. 7 Smart applications in Atlanta city. https://inform.tmforum.org/internet-of-everything/2016/09/developing-smart-city-roadmap-atlanta/

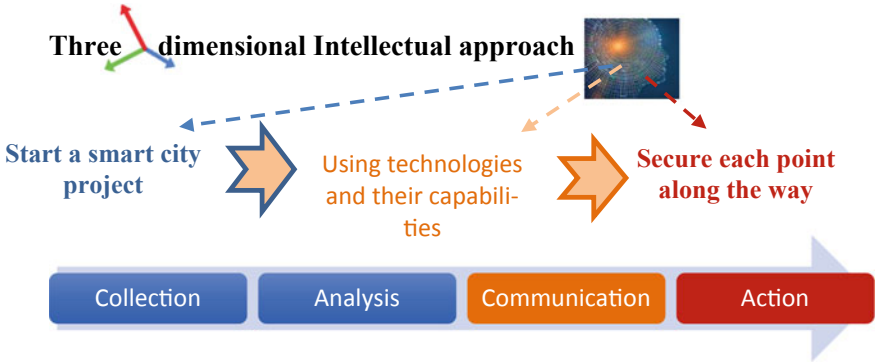

Fig. 8 Three-dimensional intellectual approach for intelligent cities (authors)

Steps will be discussed as follows:

7.1 Start a Smart City Project

- **The new way of living**

The new vision of the life which supports and improves its users' lives is looking for appealing city districts that use smart infrastructure to influence the lives of people and communities, the success of businesses, and the health of the planet around them, by providing a fully integrated, bespoke end-to-end solution. In order to create more caring, interconnected urban settings that are aware of and respond that changing situations (Abdoullaev, 2011).

This system integrates renewable and intelligent energy supply and efficiency, smart buildings, and e-mobility charging, and it should be considered the residents want a social and cultural fabric that appeals to them and gives them a sense of place (Vershinina et al. 2020). So the Infrastructure for education, residential infrastructure, health care, and security are the main needs for a new way of living.

- **The Innovation Strategy**

The innovation strategy is a company-wide strategy that supersedes all other strategies and plans, it should create a consistent and cohesive approach to projects, it lays out the city's roadmap which calls for innovation and creativity in all aspects in order to create a cultural shift for all community members, and it includes residents and employees to prepare them for the workplace and the changing workforce.

This can be accomplished by leveraging technology where opportunities for the digital economy exist, allowing for the transformation of service delivery with a new business model, developing company policies, and analyzing all processes, initiatives, and programs through a fresh lens (Vitalij et al. 2012). Furthermore, everyone should be permitted to comprehend the new direction in order to realize the concept of working together with the same goals.

7.2 Using Technologies and Their Capabilities

- **Creative and talented skills**

The ideal work-life balance needs necessitate flexible working hours with a daily pattern that is diverse, as it allows us to have new and exciting experiences every day. It can be achieved by finding smart solutions that may improve the lives of individuals and businesses (UN-Habitat, 2012). Smart cities are becoming more efficient and productive places to do business by using widespread information technology as well as resulting in the emergence of a new workforce reality.

- **Network's broadband** (Virtual collaborative spaces to succeed)

The existence of ICT as "the distinguishing factor of smart cities" is insufficient, and an overabundance of ICT has even been identified as a major flaw in a number of smart cities. Nonetheless, integrating ICT into a city can open up new possibilities and alter the city's landscape. It can be achieved by creating successful virtual collaborative spaces which required technological support ideas, such as sensor and internet of things concepts, Wi-Fi, intercommunicating microprocessors, and so on.

- **Potentials of Smart Cities**

They are the features that are available in the smart city which able to implement infrastructure management "water, electricity, information and communications, transportation, emergency services, public utilities, buildings, trash management, and sorting".

The smart city should be designed to achieve the followings:

– The existence of a wireless sensor network, which is a network of smart sensors that can measure a variety of data and broadcast it all at once to residents or authorities.
– The Internet speed in smart cities should be extremely fast.
– The citizen receives his home with all of the basics, including internet lines, a telephone network, a television network, and water and electricity meters, all of which are connected to the Internet.
– It is feasible to track any citizen's water or electricity consumption.
– Streets, as well as street advertisements, are monitored with cameras and managed over the Internet.
– The removal of negative phenomena such as robberies and crimes in smart cities, due to the existence of surveillance cameras in all streets and their co to a single room, as well as the ease with which the criminal may be identified.
– Using the Internet to obtain licenses and official documents in order to reduce direct contact between the applicant and the employee.
– Secure each point along the way (Fig. 9).
– A truly "smart" city should work for the benefit of all citizens which can be achieved by the implementation and ongoing assessment, although the commer-

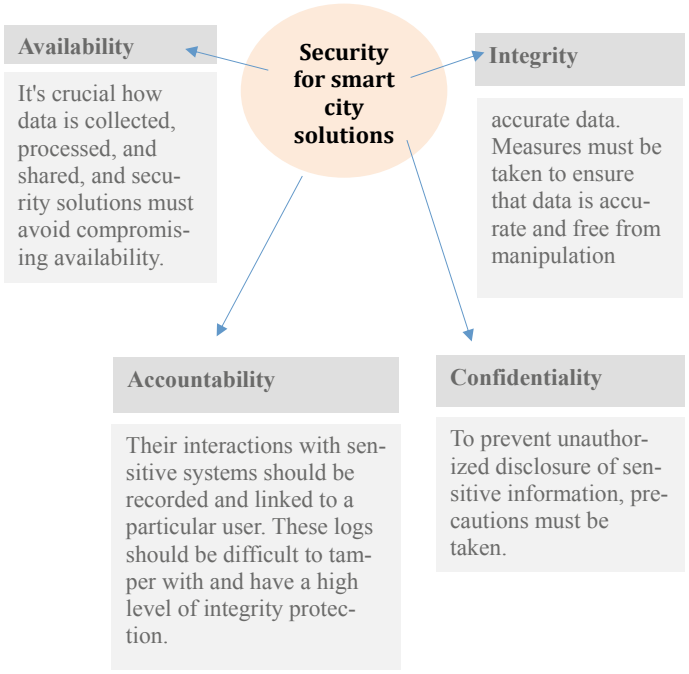

Fig. 9 Four core security objectives for smart city solutions

cial and public organizations are beset by constant change and a lack of clarity in terms of information security standards, governance, and legal duties, leaving them unclear of how to proceed with big development initiatives.

To maintain effective and efficient communication, these networks re-quire monitoring and administration, which can be achieved by an efficient smart city application, efficient networks, and integrate advanced monitoring and control technologies, the study suggested three-dimensional intellectual sustainable approach, that can be employed to construct a smart city and secure each step along the way (Fig. 10).

8 Conclusion

- Smart solutions can develop the lives of citizens, in adding to businesses.
- Smart city projects must be accessible to the general public via an open data portal or mobile app. Users can engage with the data and complete personal tasks like paying bills, finding optimal transportation options, and calculating home energy consumption. The most significant difficulty is connection, as thousands, if not

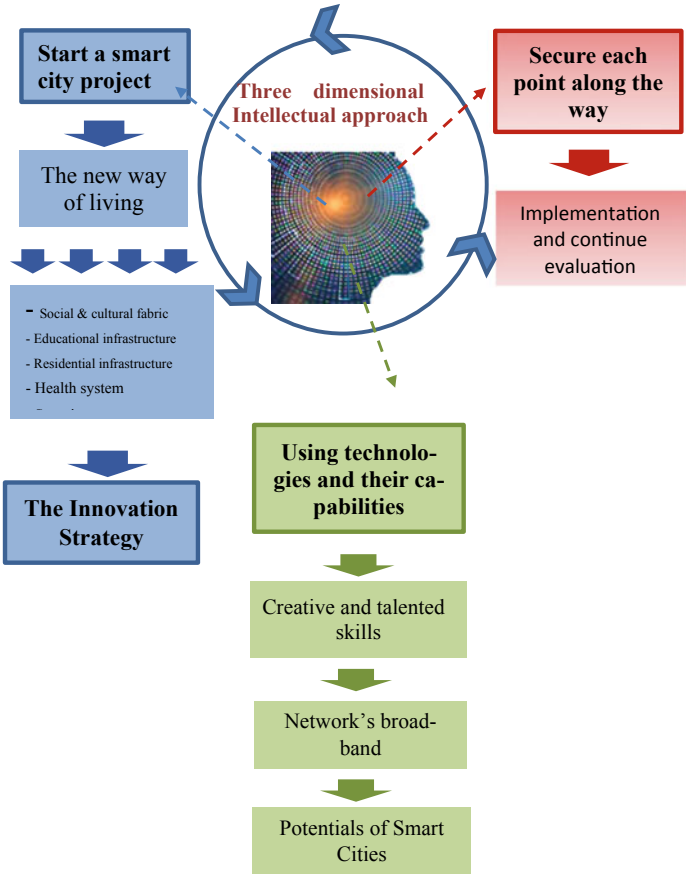

Fig. 10 Detailed suggested three-dimensional intellectual sustainable approach for establishing intelligent cities (authors)

millions, of IoT devices must connect and function together. As demand grows, this will allow services to be connected and continuing improvements to be made.

- Social elements that contribute to a cultural fabric that appeals to residents and offers a sense of place must be considered in smart cities.
- It's crucial to think about the technologies and data that will need to be collected and shared, as well as the tools that will be required to enable that experience.
- The study suggested three-dimensional intellectual sustainable approach, that can be employed to construct a smart city: Begin a smart city project with the use of technology and its possibilities, and secure each step along the way.
- The significance of appropriate policy initiatives. As a result, jobs created in smart cities must be accompanied by stronger policy in order to guide future approaches to economic development and assist workers in developing skills for the new world of work.

- Businesses in smart cities must ensure that their employees have the necessary skills.
- While technologies provide solutions and increase users' quality of life, more research is needed to evaluate the impact of excessive or reliance on technology on long-term hazards and how to avoid them in the future.

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