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A Journey from Conventional Cities to Smart Cities

Aman Kumar and Jasvir Singh Rattan

Abstract

In the 1990s, all the cities were conventional cities because at that time there was no concept of the Internet. In the last decade, the concept of smart city has been spread all over the world with the advancement of Internet, and it puts an impact on both small and large cities. In the present scenario, the urban areas affected by various problems and smart cities are only the solutions. The definition of smart cities depends on the word of "smart," which means a digital city, intelligent city, and sustainable city. The basic concept of the smart cities is that the city should be "green," more "accessible," and more "liveable." This chapter explores the changes made in the conventional cities to become the smart cities, which helps to improve the lifestyle of city people and reduce waste and pollution.

Keywords: smart cities, smart environment, digital city, sustainable urban development, conventional cities

1. Introduction

On the inception of civilization, when man decided to settle and abandon a wandering lifestyle, his immediate requirement was a suitable shelter. Firstly, he lives
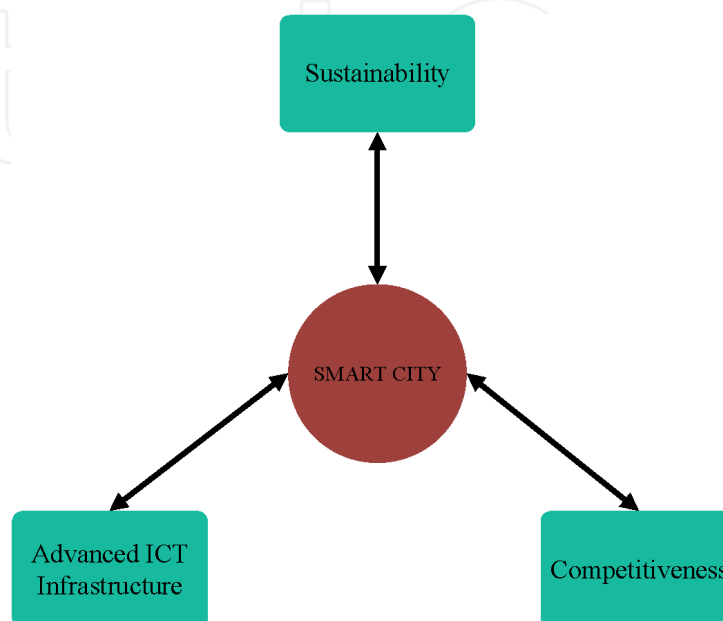

Figure 1.
Main goals of Small City projects.

in caves, then shifted to man-made huts, from man-made to villages and lastly shifted to conventional cities. The conventional cities defined as the cities in which people live without using the latest technology in all aspects. The latest technology related to the smart infrastructure, smart traffic arrangements, and smart living standards of life. But in present scenario, with the fast growth in population, create challenges to the government as well as public sector. So, smart cities provide the best solution in such cases for the better life of urban areas. The first smart city of the world, which
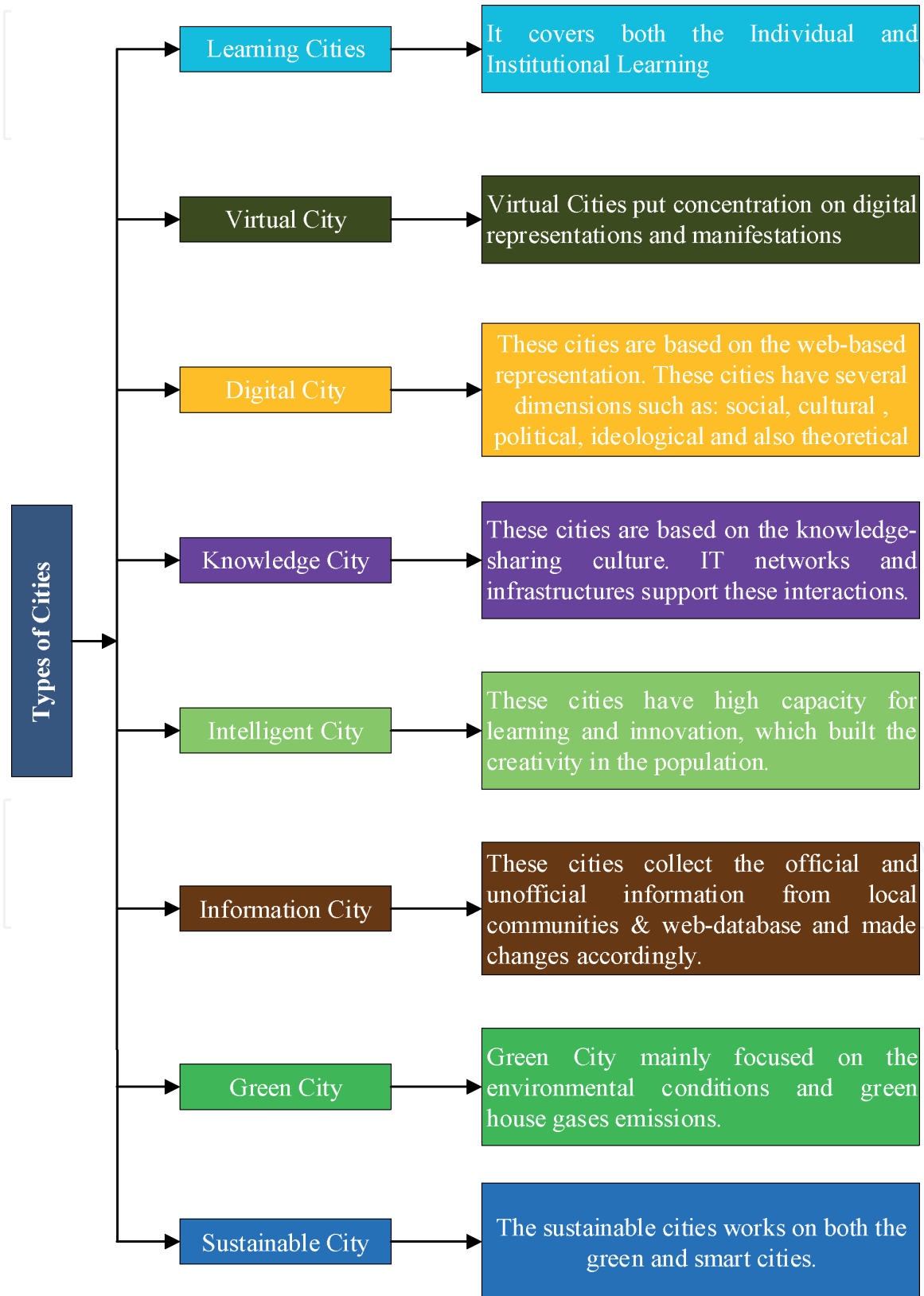
Types of Cities		
Learning Cities	→	It covers both the Individual and Institutional Learning
Virtual City	→	Virtual Cities put concentration on digital representations and manifestations
Digital City	→	These cities are based on the web-based representation. These cities have several dimensions such as: social, cultural , political, ideological and also theoretical
Knowledge City	→	These cities are based on the knowledge-sharing culture. IT networks and infrastructures support these interactions.
Intelligent City	→	These cities have high capacity for learning and innovation, which built the creativity in the population.
Information City	→	These cities collect the official and unofficial information from local communities & web-database and made changes accordingly.
Green City	→	Green City mainly focused on the environmental conditions and green house gases emissions.
Sustainable City	→	The sustainable cities works on both the green and smart cities.

Figure 2.
Different types of cities.

was introduced in the year of 2014 is in Seoul the capital of South Korea [1, 2]. The strategic goals of Seoul smart city projects are Sustainability, Advanced Information and Communication Technology (ICT) and Competitiveness as shown in **Figure 1** [3]. The developing country like India, the question is not that what to build, but where to build. The land resources are very limited and population growth at a very fast rate. In the case of Singapore from the independence of 1965, they reclaim the land about 23% using the sea. As the urban populations rise the world will face unprecedented challenges, like house, transport, and food. In the future as the rural population decrease ensuring food stability will be key. Singapore adopts good way to grow the food in the urban environment [4]. Traditional land farming grows produce outside on a flat linear area. But sicinius system grows food inside in any building expanding agriculture's footprint up into the sky. This is called vertical farming. Vertical farming is good for the areas which have land scarcity [5]. As populations age and incidence of diabetes continue to across the developed world, so, it is important to encourage the citizens to eat smart and well [6]. The main objectives of this chapter are: (a) the difference between smart cities and conventional cities (b) artificial intelligence in smart cities (c) various definitions of smart cities and (d) smart city indexed parameters (**Figure 1**).

2. Literature review

2.1 Types of cities

The various types of cities which include Learning, Cities, Virtual City, Digital City, Knowledge City, Intelligent City, Information City, green City and Sustainable City are defined in **Figure 2**.

2.2 Definitions of smart cities

The various definitions of the smart cities have been described in **Table 1**, which are taken from the various research papers from the origin of the smart cities concept.

Reference	Definition
Hall [7]	In smart cities the author Hall mainly focused on the good condition of building and infrastructures with the addition of security of city people.
California Institute [8]	The California institute describes the smart city on the basis of smart community. The smart community is that community which is ready to work with the latest technology.
Caragliu et al. [9]	Caragliu defined the smart city on the foundation of human being, smart capital and modern IT infrastructure which are the fuel of sustainable city and also provide high quality life to the urban civilization.
Su et al. [10]	Smart City is the product of Digital City combined with the Internet of Things.
Batagan [11]	A Smart City well-performing built on the "smart" combination of endowments and activities of self-decisive, independent and aware citizens.
Lu et al. [12]	Smart City is a city in which it can combine technologies as diverse as water recycling, advanced energy grids, and mobile communications in order to reduce environmental impact and to offer its citizens better lives.
Dameri [13]	AAuthor defined the smart cities on the basis of geographical area in which he include various parameters such as: quality of life, intelligence development, use of green and eco-friendly resources and able to state the rules and policy for the city government and its development.

Table 1.
Definitions of smart cities from literature.

3. Conventional cities

These cities have very intricate systems of organized people, business, "transportation", "communication networks", "services", and "utilities" [14, 15]. As the city grows, they create the technical, social, economic and organizational pressures that put economic and environmentally sustainability in jeopardy. The conventional cities use the non-renewable resources of energy. In these cities, there is no proper management for garbage and control pollution [3]. The typical type of conventional city shown in **Figure 3**.

In conventional cities the people are suffering from many problems such as water issues, insufficient of electricity, poor traffic management, poor lifestyle [16], conventional education system, the hospitals are not well equipped, lack of employment, safety, and security, people are not much aware of the facilities and rule and regulations and growth of uncontrollable population [17]. To overcome these all the problems, the conventional cities take the transformation to the smart cities.
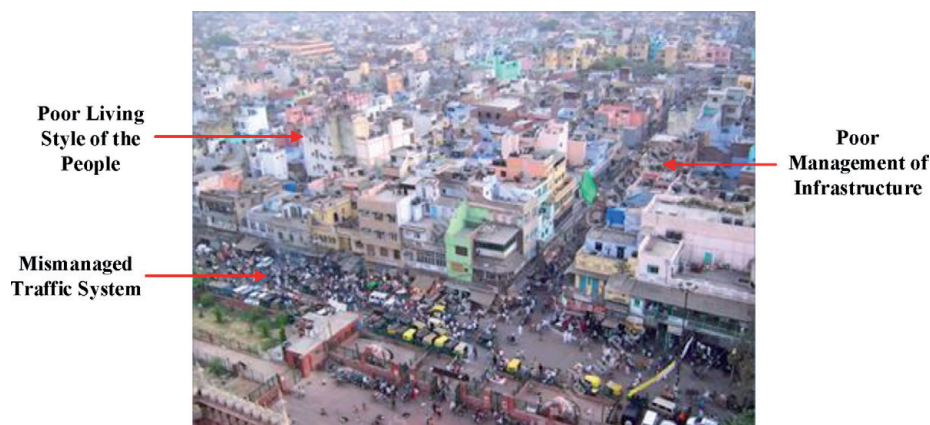

Figure 3.
Image of conventional city which is situated in India.

4. Smart city

The smart cities can be defined as "it is the future of the urban population/cities, made safe and secure and having good environment" [18]. The material used for the construction of smart cities should be eco-friendly and the city having tracking and decision making algorithms [19]. Smart cities demand carefully planning at early ages, it is important the city will fulfill the requirements of government and citizen. A clear strategy must address two key factors: "functions" and "purposes," the function refers to aesthetical appearance and operations of a city, and "purposes" refers to the benefits promised by a smart city model [20].

5. Background of smart cities

With the increase in the population and the growth of urban cities, cities have been endowed unprecedented power on politics, economic and technology and play a crucial role in the world. As reported in history, every global crisis related to finance or energy always triggers a technical revolution, and the winner will lead the economic development as shown in **Figure 4** [21]. Traditional city development pattern based on straightforward use of non-renewable sources such as coal-fuel, petroleum, and natural gas, which results in pollution and creates a problem for
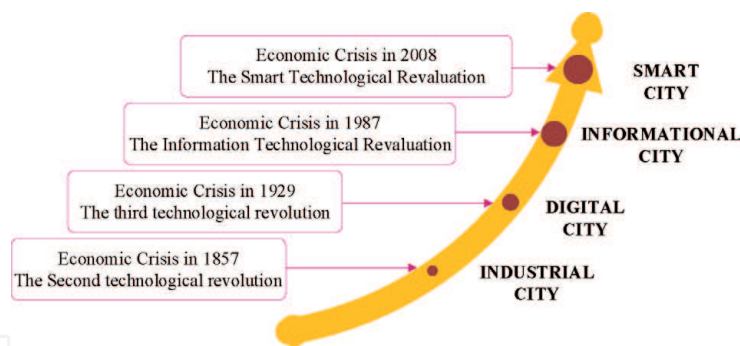
Figure 4.
Background of smart cities.

people who work in that area. The "sustainable development", "Smart Growth", and "Intensive Development" have been proposed by the government mostly in all the countries [22]. The concept of the smart city has been proposed by the IBM company at the end of 2009 following "smart earth" and it receives attentions of governments, scholars, and citizens.

In developing countries, the word "smart" is related to the mental ability of the people to understand the technology and use it in a right way. To prepare the urban population in such a way, so they can deals with the problems smartly and find the perfect solution in an eco-friendly way. The major problem in the urban cities is energy crises. So, in smart cities foremost focus of the government is that to promote the quality of urban operations and the policies of the urban development [23].

5.1 Basic requirement for a city

The basic components for every city are Land, People, Government, and Infrastructure.

Land: Land is the same for both cities conventional and smart cities. The land is that area, where the city is to be growing.

People: The people in conventional cities are different from smart cities. In conventional cities, people are not much aware of the latest technological features. But in smart cities, people are aware of smart technology such as the Internet of Things (IoT), wireless communication and cashless technology.

Government: Support of the government is very important and it is the responsibility of the government to introduce the latest technology in the smart cities and also provide awareness among the citizens.

Infrastructure: Now in this present era, the land space is very limited, and it is essential to place the infrastructure in such a way so every citizen has comfortably sufficient space for their living.

5.2 Applying the smart cities

Currently, the construction of the smart cities is on-trend, more than 50 counties work on the concept of smart cities. There are many problems in the urban areas such as environmental issues, overpopulation and traditional methods are not able to cope up from that problem [24]. From the last decade, all the countries begin to start working on Internet of Things (IoT), cloud computing, networking and other innovative technologies which helps to make the cities intelligent for the purpose of energy conservation and improving their long-term benefits for future [25]. The world's most top 10 smart cities are London, New York, Amsterdam,

Paris, Reykjavik, Tokyo, Singapore, Copenhagen, Berlin and Vienna reported by IESE Cities in Motion in the year 2019. The representation of these cities with their location is shown in **Figure 5**.

The distribution of the cities is shown on the world map in **Figure 5**. As per indexing of IESE 2019, they indexed 165 smart cities in all over the world depending on their dimensions such as "Economy", "Human Capital", "Social Cohesion", "Environment, Governance", "Urban Planning", "International outreach", "Technology", "Mobility" and "Transportation".

5.3 List of smart cities continent wise

The given table shows the countrywise list of the smart cities which are indexed by the IESE smart system 2019. This table categorized the countries according to their continent with their ranks. In Asia the Tokyo city of Japan placed in first rank as per the smart city index and in Australia the Sydney city
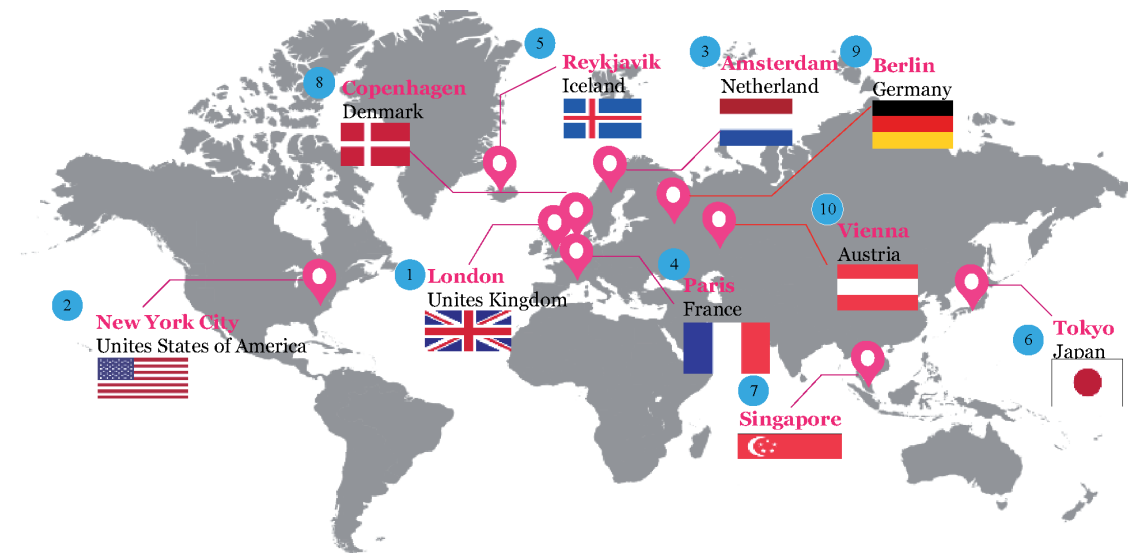

Figure 5.
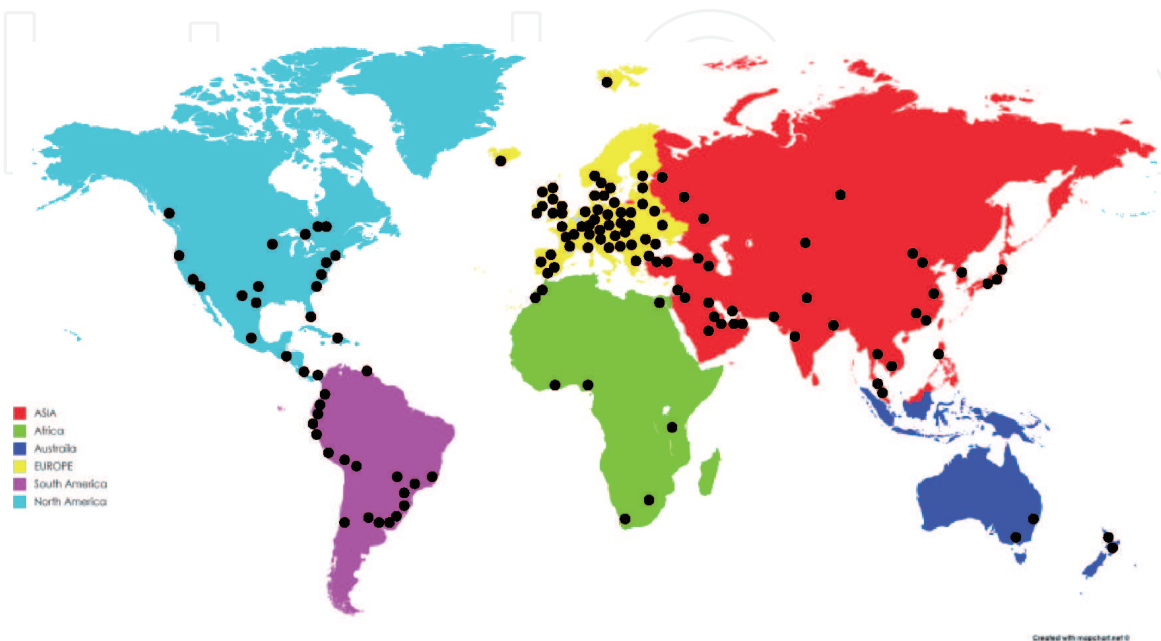*Top 10 smart cities in the world (indexed by IESE smart system).*

Figure 6.
Geography distribution of smart cities (continental wise).

of Australia placed in the first rank. Similarly, the other cities with their country name placed rankwise, indexed in **Table 2** [26]. And the geographical distribution of smart cities shown in **Figure 6**.

5.4 The framework of smart cities

The framework of smart cities is divided into six parts such as smart mobility, smart environment, smart people, smart living, smart governance, and smart economy as shown in **Figure 7** [27, 28].

Continent	Cities (countries)
Asia	Tokyo (Japan), Singapore (Singapore), Hong Kong (China), Seoul (South Korea), Taipei (Taiwan), Shanghai (China), Osaka (Japan), Tel Aviv (Israel), Nagoya (Japan), Beijing (China), Dubai (United Arab Emirates), Kuala Lumpur (Malaysia), Bangkok (Thailand), Guangzhou (China), Istanbul (Turkey), Shenzhen (China), Ho Chi Minh City (Vietnam), Jerusalem (Israel), Tbilisi (Georgia), Doha (Qatar), Abu Dhabi (United Arab Emirates), Almaty (Kazakhstan), Baku (Azerbaijan), Ankara (Turkey), Jakarta (Indonesia), Kuwait City (Kuwait), Amman (Jordan), Bangalore (India), Tianjin (Chin), Manama (Bahrain), Mumbai (India), Manila (Philippines), Riyadh (Saudi Arabia), New Delhi (India), Kolkata (India), Lahore (Pakistan) and Karachi (Pakistan).
Africa	Casablanca (Morocco), Tunis (Tunisia), Douala (Cameroon), Cape Town (South Africa), Nairobi (Kenya), Cairo (Egypt), Johannesburg (South Africa), Rabat (Morocco) and Lagos (Nigeria).
Australia	Sydney (Australia), Melbourne (Australia), Wellington (New Zealand) and Auckland (New Zealand).
Europe	London (United Kingdom), Amsterdam (Netherlands), Paris (France), Reykjavik (Iceland), Copenhagen (Denmark), Berlin (Germany), Vienna (Austria), Stockholm (Sweden), Oslo (Norway), Zurich (Switzerland), Helsinki (Finland), Madrid (Spain), Munich (Germany), Barcelona (Spain), Basel (Switzerland), Bern (Switzerland), Geneva (Switzerland), Frankfurt (Germany), Hamburg (Germany), Goteborg (Sweden), Dublin (Ireland), Milan (Italy), Rotterdam (Netherlands), Lisbon (Portugal), Edinburgh (United Kingdom), Prague (Czech Republic), Brussels (Belgium), Dusseldorf (Germany), Cologne (Germany), Stuttgart (Germany), Lyon (France), Eindhoven (Netherlands), Valencia (Spain), Birmingham (United Kingdom), Glasgow (United Kingdom), Tallinn (Estonia), Warsaw (Poland), Bratislava (Slovakia), Antwerp (Belgium), Budapest (Hungry), Vilnius (Lithuania), Rome (Italy), Seville (Spain), Manchester (United Kingdom), Leeds (United Kingdom), Malaga (Spain), Riga (Latvia), Nice (France), Moscow (Russia), Linz (Austria), Palma de Mallorca (Spain), Marseille (France), Duisburg (Germany), Porto (Portugal), Ljubljana (Slovenia), Liverpool (United Kingdom), Wroclaw (Poland), Nottingham (United Kingdom), Lille (France), Zaragoza (Spain), Zagreb (Croatia), A Coruna (Spain), Bucharest (Romania), Murcia (Spain), Athens (Greece), Bilbao (Spain), Florence (Italy), Turin (Italy), Minsk (Belarus), Kiev (Ukraine), Sofia (Bulgaria), Naples (Italy), Belgrade (Serbia), Saint Petersburg (Russia), Sarajevo (Bosnia and Herzegovina), Skopje (North Macedonia) and Novosibirsk (Russia).
South America	Santiago (Chile), Buenos Aries (Argentina), Montevideo (Uruguay), San Jose (Costa Rica), Panama (Panama), Bogota (Colombia), Rosario (Argentina), Rio de Janeiro (Brazil), Brasilia (Brazil), Sao Paulo (Brazil), Mexico City (Mexico), Medellin (Colombia), Santo Domingo (Dominican Republic), Cordoba (Argentina), Lima (Peru), Curitiba (Brazil), Asuncion, (Paraguay), Cali (Colombia), La Paz (Bolivia), Belo Horizonte (Brazil), Guayaquil (Ecuador), Guatemala (Guatemala) and Caracas (Venezuela).
North America	New York (USA), Los Angeles (USA), Chicago (USA), Toronto (Canada), San Francisco (USA), Washington (USA), Boston (USA), Montreal (Canada), Ottawa (Canada), Miami (USA), Phoenix (USA), Dallas (USA), Denver (USA), Philadelphia (USA), Vancouver (Canada), Houston (USA), Quebec (Canada), Seattle (USA), San Diego (USA), San Antonio (USA) and Baltimore (USA).

Table 2.
List of smart cities (continent wise by their ascending order).

① SMART MOBILITY	② SMART ENVIRONMENT	③ SMART PEOPLE
• Availability of ICT Infrastructure • Accessibility • Sustainable, innovative and safe transport system	• Environmental Protection • Pollution • Sustainable Resource Management	• Creativity and flexibility • Level of qualification • Participation in public life • Open-mindedness • Social and ethical plurality
④ SMART LIVING	⑤ SMART GOVERNANCE	⑥ SMART ECONOMY
• Cultural facilities • Educational facilities • Health conditions • Housing quality • Touristic Activities	• Participation in decision-making • Public and Social Services • Political Strategies and perspectives	• Entrepreneurship • Flexibility of labour market • Innovation • Productivity

Figure 7.
The framework of smart cities.

6. Artificial intelligence for smart cities

Artificial intelligence is an interdisciplinary science and technology founded on many disciplines such as Computer Science, Biology, Psychology, Linguistics, Mathematics, and Engineering [29]. The leader of artificial intelligence John McCarthy defined AI as "The science and engineering of making intelligent machines, especially intelligent computer programs" [30]. Artificial Intelligence is that technology, in which we program the machine in such a way, that they think intelligently and works accordingly human intelligence. AI works on the basis of the human brain, how the human brain thinks, decide to work and find the solution of the problems [31]. In smart cities artificial intelligence plays a crucial role because in
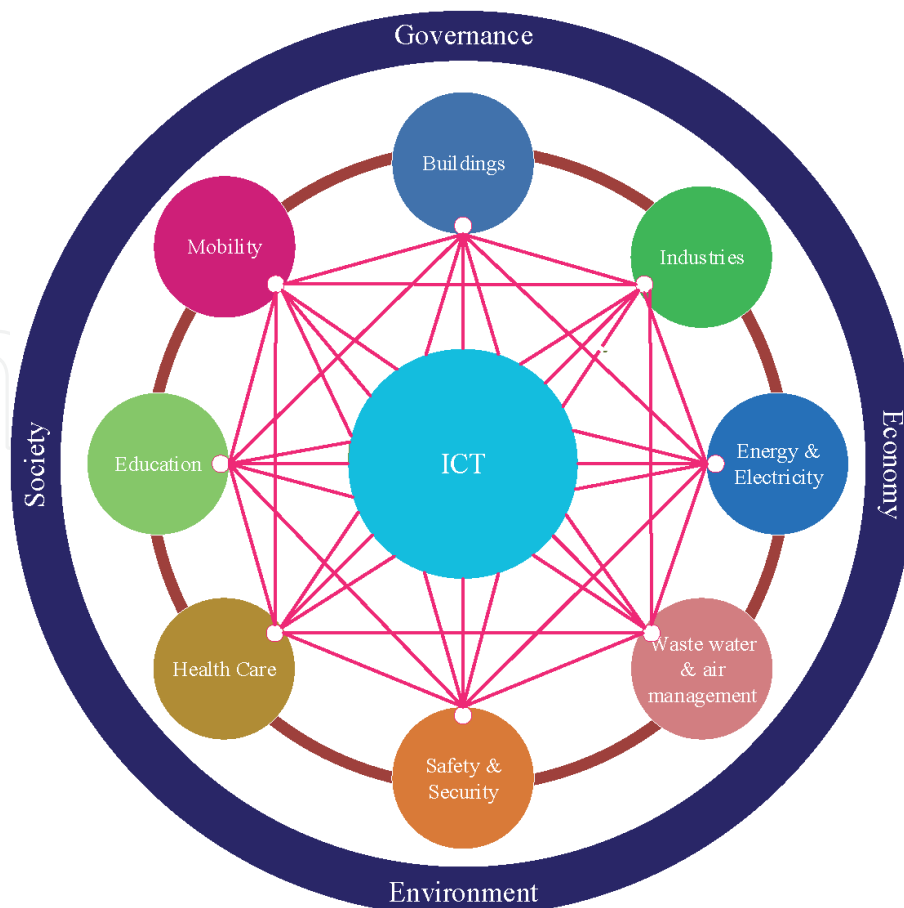

Figure 8.
The infrastructure of smart cities.

smart cities, the data is big so we need big data studies by using artificial intelligence [32]. The infrastructure of smart cities with various parameters shown in **Figure 8**.

7. Smart cities indexed parameters

By IESE Cities in motions, they defined nine parameters, on the bases of these parameters we indexed the smartness of the cities. These nine parameters are: Economy of the city, Human Capital of the city, International relation of the city, Medium of the Transportation inside the city and with connected cities, Environmental conditions, advanced technology, urban planning, governance, interaction of the people and Infrastructure as shown in **Figure 9** [33].

7.1 Economy

The economy plays an important role to make the city smart with their advancement in the public sector. The economic dimension includes; plans of local economic development, initiatives by entrepreneurs and plans by industry.

7.2 Human capital

The main focus of the smart cities to improve the human capital. The human capital includes following parameters such as: higher education, research programs, business school, Museum and art gallery etc, [34]. A smart governance only works if the human capital retaining that talent and promoting creativity.

7.3 International outreach

The international outreach means that the smart city has that brand so that become the favorite place for the tourists. The international outreach also contains the foreign investments and representing the city in global level.
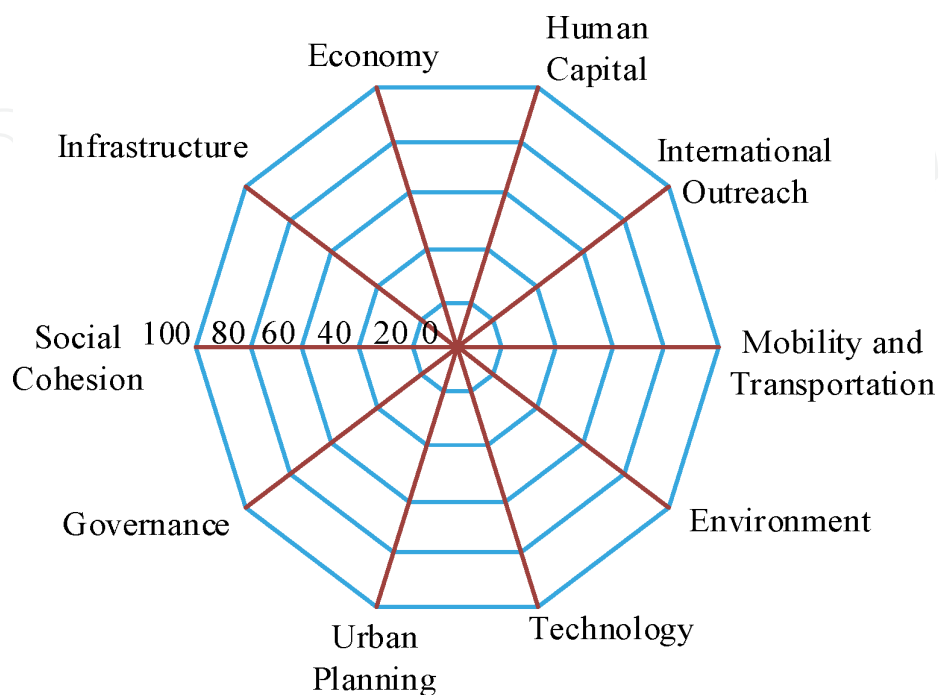

Figure 9.
Smart City indexed parameters.

7.4 Mobility and transport

The future cities are facing two problems in the area of mobility and transport: (a) access to public areas and (b) movement inside the city. The mobility and transport contain both the vehicle and infrastructure parts. So, that in smart cities use those types of vehicle which having low CO_2 emissions. And as per the infrastructure point of view, it should be free and traffic jams and well organized. The main smart cities mobility and transport parameters are: traffic index, metro length, metro stations, flights, high-speed trains and gas stations.

7.5 Environment

The environment should be green, clean and free from all types of pollutions. To clean the environment from the pollution by planting the anti-pollution trees, support green buildings system and use alternative sources of the energy. The indictor of the environment which showing their index in smart cities are: CO_2 emission, renewable water resources, solid waste management and pollution index.

7.6 Technology

The technology is not only the important aspect of the smart cities, but it is the backbone of the cities that make them "smart" [35]. Technology puts an important impact on the smart cities, it increases the quality of life, provides safety and security. The various indicator of technology are social media, smart mobile phone used by city people, WiFi supported city and Camera Security.

7.7 Urban planning

Urban planning mostly contains all types of infrastructure which includes buildings, railway lines, airports or seaports. The indicators of the urban planning are: no. of household uses sanitation facility, high-rise buildings and number of people per household.

7.8 Governance

Governance describes the effectives of the people to solve the city problems. The governance indicators are research centers, embassies, government buildings, government development index and democracy [36, 37].

7.9 Social cohesion

Social cohesion defined as "it is a sociological dimension of the city, as the degree of consensus among the members of a social group or as the perception of the belonging to a common situation or project" [38]. The indicator of the social cohesion is rate of crime, health, hospitals, happiness index, price of property, mortality and terrorism [39].

7.10 Infrastructures

The infrastructure contains all types of building structures, and other city structures. The material used during the construction should be eco-friendly and after destruction, it is useable for other construction purposes (**Figure 9**).

8. Conclusion

In this era, we are mostly dealing with the Internet which is becoming smarter and more intelligent than ever. As per the definitions of the smart city, it should be including efficient water, primary health, smart grids, wireless Internet access, efficient waste, road safety, clean energies, transportation and education, and e-governance. The security of the smart city is very important and it depends mainly on the factor such as city governance, socio-economic and technological dependence. The primary role of these factors to resolve the security-related issues. ICT technology plays an important role to form a smart city. This does not only help to solve the infrastructure-related problems, but also take care of security-related problems. The ultimate mission of the smart city is to brave innovative creativity by the government and commercial sector to initiate the financial progress and develop day -to day quality of life by empowering local development and connecting latest technology to benefits the residents. The key parameters of smart cities are small buildings, smart energy, ease of mobility and personal security. This chapter discusses how conventional cities converted to smart cities using latest technology.

In smart cities, various technologies adopted to make citizen life comfortable and healthy. But it is also the duty of country citizens to maintain that facility properly. The smart city concept is very good and unique, which provide all the basic amenities for urban citizens. The contribution of this chapter in the area of smart cities is that, it provides the various parameters which decide the ranking of the smart cities in all over the world. The major key points are: advancement in the area of artificial intelligence, work with smart technology for smart cities and basic components of sustainable development. The future scopes of the smart cities will be work on "smart citizen" to provide the digital solution in the field of healthcare, education and other government policies.

Conflict of interest

"The authors declare no conflict of interest".

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