The new advanced Cities
From the Green and Digital to the Smart Cities

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Abstract

The city has always brought within itself the characteristics of the historical period in which it existed and of the population that inhabited it. In the last years new kind of cities were born, some of them are called green, some others digital and then some are the Smart Cities. The latter has the same features of the first two cities, but them are also committed into satisfying the expectations of its population and caring about citizens' welfare first. The Smart Cities are the result of technological progress and the search for environmental sustainability. The city was born as a consequence, almost obvious, of the improvement of human skills: many nearby houses represented a possibility of bringing together resources and abilities in an almost uninhabited land.

Small villages have become towns, cities and metropolitan cities in which all the technological discoveries were applied and made concrete in the services that these cities could then offer to their inhabitants. The cities, and its various existing types, up to the green cities and digital cities and finally the Smart Cities will be described, as the apex of the discoveries of the digital and sustainable people, who respects the environment in which they live, indeed, which regenerates the environment from past pollution. In these cities, people live within a virtual environment too.

These cities are in continuous evolution, extremely rapid, in a competition to each other, made up of skills and technological discoveries, which contain within their borders innovative services for all of its inhabitants, and all its stakeholders. This paper discovers the way of the first inhabited centers towards Smart Cities.

Keywords: The City, Greater City, Green City, Digital City, Smart City.

1.Introduction

The word "city" comes from the Latin word "civitas" [1]. It is an important center [2], organized by a population with different skills [3], where given the lack of self-sufficiency in production [4], it must come into contact with other communities, to meet the needs of its inhabitants [5] [6]. Unfortunately, there is not a general and homogeneous definition of the city and this catch made it more difficult to compare the meaning of "city" between different countries and over the ages [10].

However, each country has its own method of defining a city which is based on different criteria about the size of the territory, the density, and other characteristics, as the urban functions. Therefore, the Organization for Economic Co-operation and Development (OECD) [11] claims that comparing the number of cities in the world based on the number of cities declared by the countries will unfortunately give a wrong analysis [12], in fact there may be more cities in a country since it defines a city with different criteria from other countries.

To solve this problem, the OECD has developed a definition of a city which identify it in a densely populated area. They also defined the town as intermediate density areas and the

rural areas as thinly populated areas [13]. It is possible to assert that there are cities with a high population, with much more inhabitants compared to other cities with a much lower population. To distinguish the cities based on the number of inhabitants, the European commission has drawn up a dimensional classification that ì classifies a city from Small to Global.

The Small cities are those which have between 50,000 and 100,000 inhabitants, the Medium cities between 100,000 and 250,0000, the Large cities have between 250,000 and 500,000, the XL cities have between 500,0000 and 1 million of inhabitants, the XXL cities have between 1 million an 5 million inhabitants. The global cities have over 5 million inhabitants [14]. Following this new definition which declares that a settlement with at least 50'000 inhabitants can be called "city"[15], it is possible to find that there are 800 cities in the European Union, and almost 700 of them are Small and Medium [16].

Some European countries have only one city, such as Luxembourg, Malta and Iceland. Some others have just two cities such as Slovenia and Cyprus. The countries with the highest number of cities in Europe are Italy which has 74 cities, Spain has 98 cities, France has 114 cities and Germany which has 125 cities [17]. There are also other types of city definitions based on their characteristics. The Greater Cities are the ones which extended their boundaries beyond the urban center.

Then, the green cities which have the gaze turned towards the respect for the environment, the digital cities have both virtual and physical environment. All of them are manifestations of the progress of that small village that has evolved together with its inhabitants. Nowadays, the cities increased their performance in terms of size, productive capabilities, social inclusion and sensitivity towards the external environment, from a sustainable and a digital point of view. It is really possible to observe that the virtual environment is also tangible in the urban space of a city, through its services, and the Smart City represents the most concrete manifestation of this phenomenon.

2 The Greater Cities

The Greater Cities are called in this way by the European Commission [18]. The European Countrie that have the greater cities with the highest number of inhabitants are the United Kingdom, France, Spain, Germany, and Italy [22]. There are nineteen greater cities in the UK [23] and fourteen in Italy [24].

The most important Greater Cities of the United Kingdom are the Greater London which includes the City of London [30] [31], and Greater Manchester which includes the City of Manchester [32] [33]. In Italy there is the Metropolitan city of Rome, of Milan, Bari, Bologna, Cagliari, Catania, Firenze, Genova, Messina, Napoli, Reggio Calabria, Palermo, Torino, Venezia [34] [35] [36] [37]. Every city has the need to improve and satisfy the needs of its inhabitants and the needs that its territory imposes on them [38].

So, a city can be oriented towards environmental sustainability [39] [40] or towards the urban green [41] [42]. In this case there will be a green city [43]. And if the most of its

citizens are technology-oriented a digital city will surely rise [44] [45] [46]. These cities are certainly the result of development projects undertaken by the public and private individuals over the years. Only after those projects are developed it will be possible to define a green city, a digital city, a Smart City.

2.1 The Green Cities

The green areas of the city, such as parks and sports fields, forests, and natural meadows, represent a fundamental component of the urban ecosystem [47] [48]. Urban green areas encourage physical activity and create a refuge from the chaotic city life. Parks and gardens play a key role in the cities by providing oxygen and clean air, as well as places for recreational activities [49] [50]. Green areas are fundamental for the health, in fact being able to have access to green spaces daily, improves the well-being of the inhabitants of the city [51] [52].

The urban green is characterized by permeable surfaces with trees and plants of all kinds [53] [54]. It refers, above all, to urban parks and urban forests that grow within a city [55]. It became now an integral part of the cities. Urban Green is so much important for the environment of cities that in some country there are national strategies to manage it. In Italy there is the "National Strategy of Urban Green", which establishes criteria and guidelines for the promotion of urban forests and peri-urban forests consistent to local environmental characteristics, historical-cultural and landscape [68]. It is widely known now that trees, flowers, and vegetation embellish the urban environment of the green cities [69]. But despite that, many cities, which do not welcome green areas, can appear as wastelands in which cement, environmental degradation and pollution, predominates [70].

The image of the industrial city can be seen in almost every country in the world and green spaces have been defeated by the growing increase in the urban population [71] [72]. The importance of urban green spaces is widely understood today [73] [74] and in many urban construction projects the green is being incorporated as well [75] [76] as it is possible to see in the green walls which were born to give a greener image to the city [83] [84]. In fact, when cities run out of their green spaces to have new buildings, green walls transform urban spaces into a natural-looking environments [85] and they offer an excellent option for any urban area that wishes to increase the greenery within its borders [86] [87].
Green walls can improve air quality and offer health benefits as well [88].

It has been found that green walls absorb more noise from the traffic jam than a traditional facade [89] [90]. It means that thanks by green walls these buildings will have both a better look and a much quieter home environment than other houses. In addition to offering a better image, the increasing of urban green is useful for those areas of the city that are heavily trafficked [91]. Indeed, it is common to find long tree-lined avenues in those highly trafficked areas in the greater cities [92] [93]. Urban development can also grow from this point of view by transforming the city into a garden city in which green areas predominate in the urban landscape [94] [95]. Urban green has thus become crucial to provide relief from high density urban areas [96], and the planning of green spaces is increasingly spreading in cities [97] [98].

Thanks to the increase of the urban green in the biggest cities, their inhabitants can enjoy the benefits of living in the countryside, as clean air and green spaces, just staying inside the city and being able to take advantage of its services offered [99] [100].

The presence of large green spaces within the city has also been seen as a positive aspect for tourism [101], in fact, a city with a large green area is more welcoming [102]. An increase was also recorded in house prices located near the green areas of the city [103] [104]. This is a favorable point of view that cities could exploit for both their image and their economy. Urban green spaces can also help to reduce pollution [105]. Gardens and parks absorb carbon dioxide emissions from public and private transport. It has been discovered that trees absorb the polluting substances present in the air in the external environment and that twenty trees can compensate for the pollution caused by the average use of a car in one day [106] [107]. It is certainly not possible to reduce traffic pollution by simply filling the streets of the city with trees, but surely, they can form a buffer and slightly reduce emissions.

2.2 The Digital Cities

Urban digitalization has entered the urban fabric of a large number of cities in recent decades. The cities defined as digital have developed in a context of a new industrialization and are considered as units of the training processes of industry 4.0 [118]. Digitalization provides new opportunities for the decision-making processes of government, and it improves urban development through innovative participation methods [119]. One of them is the so-called co-creation [120], which is based on the collaboration of multidisciplinary actors who work together, in a "creation process", to discover innovative solutions to environmental issues [121] in a digital way.

This new reality, that issues many cities, can be called as "strategic digital city" which implies the use of information technology in the city management [122]. From this point of view, it is more appropriate to see digital cities as the exploration of cyberspace [123].

In fact, in these cities, people incorporated Internet technology into their everyday life [124] since the beginning of its introduction. It has now become an integral part of almost all people's lives. One of the first cities that has been called as Digital is Kyoto [125], the old capital and the cultural centre of Japan [126] [127]. This city was the first one that has incorporated digital systems into urban services for its citizens and it has integrated its digital commitment in the design of the city [128], trying to respect all the historical landscape by building the digital environment [129].

Kyoto's digital technologies concern to nanotechnology and biotechnology as well, based to its medical devices industry as biosensors and nano-level detectors. Some of these technologies also concern about health, introducing new devices for an early detection of environmental toxins [130]. A digital city can be found, in any case, in the digital services that it offers.
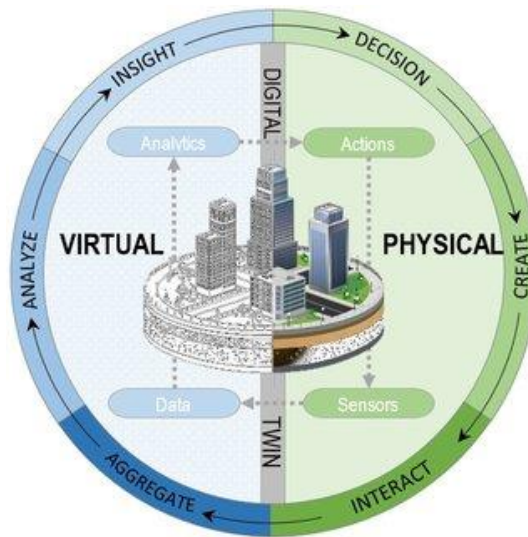
a

Fig. 1. (a): The Virtual and the Physical face of a digital city
Source: Petrova-Antonova, Ilieva, 2019 [131].

It is precisely for this reason that a digital city was often represented with skyscrapers, the symbol of an advanced city, and with another face, the virtual one, as it is possible to see in the figure 1, which is what makes Digital a city.

However, digital city is a term that was analyzed and discussed at the beginning of the second millennium. Thus, most of the scientific literature that deals with this topic dates back to the years 2000-2002.

2.3 The Smart Cities

The term "Digital City" became out of date nowadays. There are no cities trying to become just digital anymore. The cities that want to be at the forefront, they try to be competitive in environmental sustainability and incorporating green strategies with the help of technology. This combination is the key which makes a city no longer digital but Smart.

A simple example can be made by a city that aims to be green by introducing policies that promote driving electric vehicles inside its borders. Therefore, it is a political choice to reduce emissions (environmental sustainability) using electric vehicles which could be powered by solar panels (technology).

However, being truly Smart is much more than that. It is possible to find countless different solutions that the cities have obtained by introducing innovative policies from a technological and ecological point of view. The term Smart City refers to a city that uses information and communication technology (ICT) [133] to bring within it a high quality of life [134] [135], to build a more interactive environment [136] and to make its services more efficient [137].

Therefore, the ICT became the foundation for a large Smart infrastructure [138]. In fact, one of the main objectives of Smart Cities is to develop their digital environment [139].

Smart Cities strategies have been introduced as a strategic tool, that includes modern urban planning systems [140], emphasizing the importance of information and communication technologies [141], to improve the competitive profile of a city [142] [143]. This modern conception of Cities [144] integrates and incorporates aspects related to technology and innovation, to social and human capital of the cities [145].

This concept can be considered as a new approach to the philosophy of the government and city planning [146] that sees the urban area as a fair environment [147] with sustainable development goals [148]. It is possible to find many recurrent and validated definitions of a Smart City [149]. Some are very interesting, like the one given by Dameri (2013):
"*A Smart City is a well-defined geographical area, in which high technologies such as ICT, logistic, energy production, and so on, cooperate to create benefits for citizens in terms of well-being, inclusion and participation, environmental quality, intelligent development; it is governed by a well-defined pool of subjects, able to state the rules and policy for the city government and development*" [150].

With this definition it is possible to understand the central theme of technology and the important role of human capital within a Smart City. It is precisely what makes this city model so coveted. Nowadays, technology has become the centre of people's daily life, and for this reason, information technology and its knowledge can be used as a tool for raising productivity and competitiveness of a city [151]. Smart cities offer a development model for other cities [152] [153], which includes technological knowledge that can help governments improve public service delivery [154] [155].

The tendency to believe that innovative technologies automatically turn a city into a Smart City is a distorted use of the term [156]. The digital knowledge of Smart Cities must be used in an ecological key, aimed at the well-being of the population. A city which has a small urban green space [157] [158], traffic jam problems [159] [160] and emissions above the limits [161], could never be called "Smart". That would be possible only when it solves these problems with the aid of technology.

Infact, these new cities were born with the aim of giving rise to urban areas with reduced emissions [162], that undertake urban development [163] using advanced technologies [164]. Smart Cities are inhabited by people who daily make extensive use of digital tools in respect of the natural environment. Another definition is given by Giffinger et al. (2007) which demonstrates that citizens are the main tool in a Smart Cities:
"A Smart City is a city well performing in a forward-looking way, built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens" [165].

These cities must be inhabited by people who welcome technological services, that know how to use them, and that want an ecological environment. Without this, there will never be a Smart City. The city of Kyoto that was Digital in the year 2000, became Smart in 2014 [166]. This is an example which shows the fact that becoming a Smart City is a long improvement process that evolves over many years. The concrete improvement of Kyoto is visible in its environment [167] [168]. Kyoto increased and improved its technological

services, and it also has created Japan's largest urban green space, together with Tokyo [169]. Its pollution is the lowest of Japan and its resource management of water and light is the most sustainable of the country [170].

In this way, it is possible to speak about Smart Cities in term of skills improvement. Like a consequence of a long way of development, that let people live in the environment which allows them to make a full use of their skills. It also welcomes people from other parts of the world so that it receives new development aids all the time. One of the most interesting features is that Smart Cities react fast to new technological breakthroughs. And therefore, the inhabitants of a Smart City, and all its stakeholders, are already using technological tools, as soon as they are introduced to the market, and they are ready to experiment some new ones. Only after many years those technological tools will used in other cities around the world.

3. Conclusions

The man, as his natural behavior, tries to make things better, he tries to improve all the things that surround him. He designs and builds tools that allow him to improve his life. And when this tool is built, the first action is aimed at searching for its defects, to upgrade it, to have a new one which will be better and more innovative.

It is for this reason that technology has always been talked about. Even the oldest tools and machinery were innovative for that time. The old settlements, and later the cities, were the physical places of the manifestation of man's discoveries. It was the place in which knowledge manifested itself. In ancient villages it was possible to find innovative tools too, typical of its place, time and population, which were useful also for neighboring populations who came in contact with them.

Merchants, who often moved for trade, went to the discovery of new realities, and then, upon their return, they brought within their own city the discoveries they had found in the cities in which they went. After globalization, cities are all connected to each other and now they are able to exchange information easily, helping each other in technological development. Therefore, ancient villages have grown in size and technology becoming metropolitan cities, then green and digital cities. And finally, a new type of city is called Smart City.

This term has been widely used in recent years to such an extent that it is not easy to find a unique definition. The birth of Smart Cities has sparked a sort of competition between cities, which compete with each other in technological terms, each showing its skills in technology and environmental protection.

Kyoto is a city which first became Digital, when mostly of others didn't have any digital services and after years of improvements it became Smart.

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Endnotes

[1] According to Istat (National Institute of Statistics of Italy) it is not simple to give a definition of the city which will be accepted by everyone [7] [8].

[2] It is also possible that a small settlement has kept the city status from the past. As it happened in the United Kingdom in which the status of the city was conferred on San Davis in the sixteenth century, and it is still classified as a city even though it has only 2,000 inhabitants [9].

[3] In the "European Countries" are taken into account the twenty-seven Countries of the EU in the 2021 [19], the other countries of EAA [20] and the other countries of the Geographic Europe such as the UK [21].

[4] Greater London includes the thirty-two London Boroughs and the City of London [25] [26]. London Boroughs are Westminster, Kensington and Chelsea, Hammersmith and Fulham, Wandsworth, Lambeth, Southwaark, Tower Hamlets, Hackney, Islington, Camden, Brent, Ealing, Hounslow, Richmond upon Thames, Kingston upon Thames, Merton, Sutton, Croydon, Bromley, Lewisham, Greenwich, Bexley, Havering, Barking and Dagenham, Redbridge, Newham Forest, Haringey, Enfield, Barnet, Harrow, Hillingdon [27].

[5] Greater London has 8'835'500 inhabitants whereas the City of London has 8'800 inhabitants [28]. To learn more about this topic, it is available a digital map which shows the number of inhabitants for each London Boroughs [29].

[6] It provides happiness and health to the people who live in urban areas [56] [57]. Despite that, in the recent decades, there has been an intense urban expansion and it has led to a decrease in green spaces in inhabited centers [58] [59].

[7] There are many studies that show that urban green is good for health [60] [61] [62] and that large green areas should be in every city [63] [64], especially in the metropolitan areas [65] [66].

[8] "Strategia Nazionale del Verde Urbano." Legge 10/2013 [67].

[9] In this case it is also possible to talk about "Living Wall" [77], "Vertical Greening" [78], "Vertical Gardens" [79] and "Vertical Greenery System" (VGS) [80]. There are also the "Green Roofs" [81]. There have been some cases in which a real cultivation of edible vegetables has been realized through the green walls [82].

[10] The term "Industry 4.0" is related to the fourth industrial revolution, although to Engleder S. and Dimmer G. the buzzword revolution is not really appropriate [108]. The beginning of industry 4.0 is dated to 2013 [109]. The technologies that represent industry 4.0 are coming from many disciplines: cyber-physical systems, IoT, cloud computing, industrial integration, business architecture, business process management, industrial information integration and many others [110].Industry 4.0 acts also with the aim of improving the well-being of human life [111]
It should also be noted that previously Industry 1.0 came early in the 19th century. There was the steam-powered machine at that time as a revolutionary tool [112]. Then, Industry 2.0 began at the end of the 19th century [113] when important technological innovations have turned the lives of millions of people through the introduction of mass production, electrical energy and automobiles [114]. Interestingly, a large number of industries are still using the findings of Industry 2.0 [115]. Then, many technological advancements emerged during Industry 3.0 in the last decades of the 20th century [116]. It was called as digital revolution because of the introduction of information technology into the production process [117].

[11] It iss possible to learn more about the theme of Smart Cities referring to the article Carboni S., 2021, "Smart City – A new concept of green and technological city – A survey will explain the differences between two countries with a different vision of these cities" [132].