

Smart City Case Study

—Barcelona

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Abstract: The popularization of technologies such as computer technology, smartphones and Global Position System (GPS) have brought great convenience to urban life in the past few decades (Ratti & Claudel, 2016). As a result, the structure and function of urban system are changing gradually. However, the challenges are emerged as well as opportunities. In most cities around the world, the planning and management methods are hysteretic and lacking application of modern technologies. In this era, planning and policy are required to be forward-looking and high efficiency to promote healthy development of cities (Angelidou, 2015). Therefore, smart city concept has been put forward. Smart city using smart technology and data analysis to optimize urban functions and drive urban development (Albino, Berardi & Dangelico, 2015). Technologies like sensor, Information and Communication Technology (ICT) and Internet of Things (IoT) are foundations to achieve smart. However, the practice of smart city is facing many divergences and challenges. The unsuccessful and ineffective of some idealistic cities and high-tech cities announced that high technology is not the only way to make a city smarter. Sometimes, innovative thinking, design thinking and considerations of actual demand are even more important (Stimmel, 2015). Therefore, some excellent cases are worth learning and referencing. This essay will introduce Barcelona as a typical case of smart city and then summarized the achievements and experiences.

Keywords: Smart city; Barcelona; Digital city; Governs

1. Introduction

Barcelona is the largest city on the Mediterranean coast and has the second largest population in Spain (Spanish INE, 2018). The population of Barcelona is 1.62 million (Spanish INE, 2018) while totally 5.57 million people are living in Barcelona metropolitan area. In 2015, metropolitan area has a GDP amounting to €142 billion a year which accounts for almost one fifth of Spain's GDP (Barcelona City Council, 2017). Besides, Barcelona has more than 50,000 jobs and 2,500 companies working for ICT sector which gives a great convenience to the development of smart city (Barcelona City Council, 2017). As a consequence, Barcelona is becoming a successful model of global smart cities.

1.1. Policy

In Barcelona, the smart city movement started in energy field and recently projects are spreading across all sectors. Back to 2011, Xavier Trias, the new Mayor of Barcelona formed a new team which called Smart City Barcelona. The organisation take charge of integrating existing resources and technologies as well as finding new opportunities to enhance urban services for all citizens and business activities. This plan has 12 fields including energy, transportation, water cycle, waste treatment network coverage and open government. These focuses are delivered by 22 programs.

After that, Barcelona has created Smart City Personal Management Office to coordinates all the projects under the smart city tag and produced an early smart city strategy document (Department for Business, Innovation and Skills, 2013). In 2016, Barcelona city council published BARCELONA DIGITAL CITY 2017 – 2020 which aimed to continue the success in digital development (Barcelona City Council, 2016). This document tried to use data - driven technologies to improve government work, promote innovative economic development, ensure digital equality, promote public participation and safeguard digital security rather than purely focusing on high technological solutions. This strategy has three focus including digital transformation, digital innovation and digital empowerment. After a year, Barcelona's Smart City vision: an opportunity for transformation (Ferrer, 2017) has been published. This document lists ten key factors to summarize the successful experience in the transformation of smart cities and underlines the opportunities brought by new technologies to the development of sustainable city (Ferrer, 2017).

1.2. Initiatives

Under the guidance of the policies, over 100 smart city projects are in progress which mainly covering digital city, urban environment, mobility, governs & finance and inclusive. As the initiatives are brought by technology and innovation, the risks like privacy risks and inequality

are come with opportunities. Since a large number of projects are still in the process or in the preparation stage, there mainly discuss the possible advantages and disadvantages of these proposals rather than only focus on the results.

1.2.1. Digital city

According to BARCELONA DIGITAL CITY 2017 – 2020, the digital city strategy is implemented through three branches. The first is digital transformation. The city hall published data standards, usage specification and management method to promote agile and high quality of digital service (BARCELONA DIGITAL CITY 2017 – 2020). In order to serve the general public, massive data and digital technology are available for various groups. Apart from that, the city hall also develop cross-platform technologies, open data and open - source web apps to make digital more accessible and convenient (Barcelona City Council, n.d.). Above measures are used in conjunction with a large number of sensors, plus the coverage of high-speed fibre networks and central situation room in the city, the data becomes smart and agile (Department for Business, Innovation and Skills, 2013). The second focus is digital innovation. The government supports entrepreneurship and innovative economy. Appropriate disclosure of data and technology contributes to digital innovation while privacy is protected to maintain the innovation and business secret. The government also develops a city common data infrastructure, improve the business platform and increase technology investment to drive innovative economy (Barcelona City Council, n.d.). As a good example, the BCN Industry 4.0 Hub aimed to boost the digitalization of local industry through cross-platform cooperation and technology promotion. Then is digital empowerment. In general, the development of technology will cause the incensement of inequality (Rotman, 2014) while Barcelona hopes to avoid this situation. The government creates good jobs through the promotion of new technologies and devotes more efforts to develop digital education and training. More approached to new technologies are provided by E-learning platform, municipal projects and educational institutions. According to city hall, the digital education and training future-oriented and aiming to ensure the future employment. Diversiform digital skills are selectable for different genders, ages and social groups to improve the inclusive. In addition, Barcelona city hall encourages the use of technology to promote democracy. The digital transformation movement provides a better condition to public engagement in digital environments. Democracy platform Decidim Barcelona can preferably collect the opinions and intelligence of citizens.

Digitization is the most important part of smart Barcelona and also the direction of recent years and the future. Therefore, the consideration of digitization is compre-

hensive. First of all, the strategy provides an open, innovative and free economic environment. Entrepreneurship, innovation, cooperation and investment are supported which will stimulate economic growth. However, the risk of inequality and monopoly are still existing. Some companies with high technology and large amounts of data will gain huge advantages in innovation and digital progress. For example, the majority of companies that work with city council are multinational companies such as IBM and Cisco (Department for Business, Innovation and Skills, 2013). Local small business or traditional companies will get fewer benefit from the smart city movement. Faced with the broad future market, this inequality has a tend to rise. The inequality is also reflected in politics. Young people and highly educated people can gain more from open learning platforms and open data while the elderly and low-educated people get little. In addition, the privacy and security of data is also a potential risk. With everything can be monitored and tracked, privacy is hard to protect. Private data can easily be leaked or stolen by hackers if they are not protected by well-established system.

1.2.2. Urban environment

In Barcelona, the smart city movement was started in the energy field. In 2012, the Barcelona Lighting Masterplan was published. The plan aimed to use technologies to perceive the brightness of streets and the amount of passengers to adjust the brightness of street lamps. Such can facilitate pedestrians and save energy. Nowadays, the city has 19,500 smart energy meters and more than 3,000 LED streetlights (Moskvitch, 2016). These street lights not only provide lighting, but also equipped with wireless network and sensors which can detect road condition and air quality etc. The advanced lighting system not only save the energy but also attract people to some specific places in the city which helps communication and economic vitality.

In addition, Barcelona is committed to the development of green energy. The government encourages the use of solar energy. In 2006, the hot water needed by the families is basically supplied by solar energy (Casals, 2006). Barcelona Solar Thermal Ordinance also regulated that large commercial facilities like hospitals, hotels or swimming pools produce their own hot water by using solar energy. The cooling process required by industry is recommended to use sea water to reduce energy consumption. There are also initiatives about smart usage of natural resources and municipal capacity. The LoT technologies used by city parks and green belts are able to monitor water levels and humidity to achieve smart irrigation (Zygiaris, 2013). This program is implemented in 68% public parks which helped the city save about 25 % irrigation water. The advanced waste management system is also one of the symbols of smart city. Apart from

garbage classification, sensors and LoT used by the system also reduced government service waste and the effects of odors.

Those environmental initiatives not only bring aforementioned environmental benefits but also economic benefit. For example, the water cost saved by smart irrigation systems is approximately \$555,000 per year. However, the cost of maintaining these initiatives is also enormous. Since the waste management system was operating, the government has spent 1.5 billion euros in the four years (McGrath, 2017). Such a huge cost only brings a reduction in the frequency garbage trucks and odor pollution. Another disadvantage is all digital systems enhance the environmental dependence on technologies. Digitization and software are vulnerable while the environment is complicated. Once bugs occur or the consideration is not comprehensive, the consequences will be disastrous. This is also reflected in the economic aspect.

1.2.3. Mobility

The initiatives about transportation also make great efforts to make Barcelona smarter. Transports Metropolitan de Barcelona improves public transit routes through data analysis which greatly improve the convenience of transportation. The company put forward a plan to reach 95 percent of public transport coverage by any two points of the city. Hybrid buses and solar power bus shelter are used to reduce pollution. A large number of bus shelters display vehicle arrival information and a small number of them installed computers and USB charging station. Barcelona also encourages the use of public bicycles. A company called 'Bicing' build more than 400 public bicycle stations and put in 6,000 bicycles which makes it has over 120,000 subscribers. The parking system in Barcelona is a controversial project. This project placed electromagnetic sensors under the ground to monitor whether parking is occupied and whether a vehicle is parked illegally. The monitored information can be sent to the vehicle user for the convenient control of parking information. Another project about multi-story parking system has also been promoted to increase the number of parking spaces in high demand areas.

Overall, the mobility initiatives make the transportation system more convenient and reduce pollutant emissions. Moreover, the beneficiaries of these initiatives are all citizens and even tourists rather than certain groups. The only dispute is about the parking system. Opponents claim that parking spaces will be used in a very short time whether the user receive information from those sensors. The parking space which can be reserved is a waste of public resource.

1.2.4 Governs and inclusive

In order to make sure the smart city movement is developed for all citizens, the government adds better govern-

ance and inclusiveness to objectives. The government claimed good governance should not only efficient but also responsible, transparent, responsive, inclusive and participatory (Fira Barcelona, 2018). Among the proposals, open data, improve the transparency of government work and encourage public participation in plan making are key issues. From *Bústia Ciutadana*, an app launched by Barcelona City Council, citizens can make complaints and reports city problems such as the broken of communal facilities or impacts of pollution. The information will send to a central location and officials will respond and manage the issues. Another digital platform, *Open Data BCN*, is a government website which publishes open information for all citizens. Election situation, population, public facilities and economic services are available from the website so that information demanders do not have to start from scratch. In the thematic programs of 2018, government transformation, funding, sharing economy and collaborative society etc. are mentioned and prepare to implement (Fira Barcelona, 2018).

The initiatives about governs and inclusive are related to digital transformation. Both proposals are committed to scientific decision-making and provide better service to all citizens. Fairness and openness are advantages of these initiatives. However, the result may not as perfect as it supposed to be. For instance, the application of smartphones and computers will limit the participating competency of the elderly and disadvantaged groups. With the development of digitization, their voices will become weaker and weaker. The original method of promoting equality may lead to inequality. In addition, the increasing government propaganda brought by digitization may mislead the public (Jin, 2017).

2. Evaluation

Through the smart city initiatives, Barcelona has gained a series of benefits. The resource consumption has been reduced, the administration has become more efficient, the city lives have become more convenient and an innovative economy has developed. According to Juniper Research, Barcelona ranked 9th in the global smart city rankings (Juniper Research, 2017). Nevertheless, those indicators adopt by the ranking are one-sided. The advantages of Barcelona in humanity, eco-system and return on investment are remarkable. Comparing to other cities like Songdo, Barcelona shows that people make city smarter rather than technologies. Top-down planning, grand goals and high technology make a city looks smarter while innovative ideas, bottom-up opinion and suitable technology make a city real smart. The design concept of a smart city needs to be considered more to understand and meet the needs of citizens. On the contrary, technology should be used as a tool rather than a master. However, data security and equality should to be thought more seriously in the Barcelona smart city

movement. Related laws and regulatory measures need to be improved. In the final analysis, the opportunities and challenges brought by technologies coexist.

3. Conclusion

To sum up, this essay introduced the initiatives of Barcelona smart city movement and critically assessed the advantages and disadvantages. Although there are some issues and pitfalls, Barcelona is still a template worth pondering and referencing. It is worth mentioning that being a smart city is a process rather than a destination (Ferrer.2017). Like garden city, smart city is a step in urban development. Urban development needs to facilitate citizens and protect the environment for sustainable purposes.

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