Current issues and Countermeasures of Smart City Construction: the case study in China

Mingyuan Bao*

School of Management, University College London, London, UK

*Corresponding author: uceimb6@ucl.ac.uk

Abstract. As an emerging pattern in city planning around the globe, the smart city is gradually changing people's traditional way of life. Building smart cities can boost domestic demand, drive the growth of innovative industries, and promote regional economic development. It helps to enhance the core competitiveness of cities and allows them to gain a competitive advantage in the fierce regional competition. China has led the way in the construction of smart cities in recent decades. This paper provides a concise overview of the evolution of Chinese smart city policy and relevant strategies, and it analyses some of the challenges encountered along the way. The main problems can be divided into three: lack of specific plans, concerns about environmental protection, and low degree of citizen participation and information privacy. This paper puts forward relevant recommendations based on these problems as follows: scientific planning and rational layout increased investment, implementation of the concept of sustainable development, and introduction of public participation and protection of information privacy. These recommendations can aid in the growth of smart cities in China and serve as a point of reference for the relevant government agencies and smart city-related businesses in China and abroad, boosting the sustainable and healthful growth of the smart city.

Keywords: smart city; problems of the smart city; countermeasures; policies; strategies of smart city in China.

1. Introduction

Smart city has garnered attention worldwide in recent years as a solution to urban disease and a driver for economic development. With rising urbanization and environmental challenges caused by overpopulation, the smart city seems to be a solution and has become the blueprint for future cities [1]. Smart city construction is a global issue. While on one hand, smart cities share similarities and interdependencies across the globe. On the other hand, each city is unique due to its specific problems and characteristics. Cities should be confronted with tailored development strategies and solutions based on the actual issues [2]. With its tremendous amount of smart city initiatives, China has been the vanguard of the times [3]. For example, Shenzhen issued the "Shenzhen Smart Community Guidelines" in 2014 to provide a consistent framework. The development of intelligent communication systems is promoted to facilitate the building of intellectual communities. Several pilot smart communities have been established, including the Nankeng community. Nankeng community has achieved efficiency in community e-government and a considerable decrease in crime with the implementation of an integrated communication platform [4].

China's smart city research is currently deficient in theory and practice [5]. Existing research on the smart city tends to be case studies of individual Chinese cities or security and privacy issues on smart technology [1, 2]. Little is known about the problems and adverse effects caused by China's smart city policies and strategies. A few studies analyzed individual cases, focusing on China's most economically developed and technologically advanced regions [4]. The studies are insufficient because the smart cities' development in various areas in China is different to some extent, like in economically underdeveloped regions. This paper explores the evolution of China's smart city, summarising its policies and strategies and analyzing the difficulties that developed during its creation. It also offers countermeasures for these problems. The research results can provide a reference for the government and strategy-making departments to formulate policies. Also, it has a guiding

significance for local governments and smart city-related enterprises to form a sustainable smart city with Chinese characteristics, promoting smart city construction more scientifically and reasonably.

2. The development of smart cities in China

2.1 Smart city in China

The definition of the smart city is controversial and vague [6]. Multiple pieces of literature define a smart city as a city system adopting Information and Communications Technologies to address urban diseases [7]. From a broader perspective, smart cities can be analyzed from three dimensions: technology, people, and institutions [8]. Based on different industries, smart cities are subdivided into different sectors related to dwelling, ecology, economy, transportation, governance, citizens [9].

A smart city can facilitate the process of innovation, thus improving economic development in China [10]. In China, the government has played the leading role in smart city projects with a top-down approach [11]. In recent years, the Chinese government has devoted a substantial amount of funds to smart city development to address urban problems such as environmental pollution, overpopulation, and traffic congestion, and improve economic performance by grasping the new smart city opportunity [12].

2.2 The development of the political policy for smart city in China

After IBM first proposed the notion of a smart city in 2008, the smart city was successively built in Singapore, the United States, Japan, and other developed countries [13]. Subsequently, local cities in China, such as Beijing, Tianjin, and Qingdao, have proposed to explore the implementation of smart cities. It was not until 2012 that the central government delineated the application areas of smart cities. The concept of a smart city was first proposed in the report of the 19th Party Congress in 2017[14].

According to relevant policy information, the period of China's decade-long policy introduction can be divided into three periods, respectively the exploration and development (2008-2011), the active promotion phase (2012-2016), and the strategic deepening phase (2017-2020) [13]. In the first phase, the state carried out pilot work on smart cities while deploying information infrastructure and constructing e-government which drives the development of social information [13, 14]. In the second phase, a complete policy system and standard systems for smart cities were formed [13, 15]. The state strengthened network information security management by developing cutting-edge technology and integrating information [13]. In the last stage, the state emphasized how to guarantee the smart city strategy and policy’s execution while improving multi-evaluation systems and developing critical industries related to the smart city [13, 14].

2.3 Main strategies of the smart city in China

Among developed countries, the central government is devolved into local administrative bodies, and this organizational power structure drives smart city implementation as a bottom-up approach. In China, the top-down strategy is the predominant tactic [3]. Smart city has been recognized by the central government as a national strategy and is being implemented by local governments in accordance with administrative orders from a higher level of government. In the near term, the top-down strategy is more advantageous for scaling up development and execution while individual engagement is lacking in this approach. A vast of research indicates that the application of smart cities must be improved by considering the needs of the people. Citizens are the recipients of smart city services; nevertheless, citizen engagement can more effectively address issues arising from smart city development and facilitate the exchange of technology and data with service providers [2].

China has placed the green concept as an essential direction of development in its smart cities; based on traditional energy, the Chinese government develops renewable resources such as solar and geothermal energy. Regarding green transportation, the importance of public transportation is

unmistakable. Concurrently, developing intelligent systems to enhance management is a crucial component of smart city construction.

To ensure the development of smart cities, China prioritizes government investment as the primary source of funding and encourages the collaboration of multiple parties [16]. This promotes the active participation of social funds and contributes to the realization of the strategic public-private partnership model. And depending on the project's specialization, special commissioners are accustomed to matching one-by-one models to open financing channels [17].

The innovation-driven development strategy is also crucial in driving smart city development in China [18]. First, local governments give priority to the development of advanced technology and actively promote the incorporation of technological talent by using the linkage effect between universities and businesses to attract talent. Local governments also prioritize the information-sharing platform for professional and technical talent and enhance the preferential treatment policy for introducing talent [17]. Second, the enterprise side strengthens R&D and innovation, as well as international cooperation in the information industry and high-end technology required for smart cities [18].

3. Analysis of the problems

The smart city in China has entered a phase of fast growth, yet there are still several issues. China was formerly thought to have a poor top-level design, data islands, an isolated industrial ecosystem, squandered resources, and inadequate public engagement [2]. This study discusses the following difficulties according to various domains, based on past literature evaluations.

3.1 Lack of specific plans

China currently lacks a holistic top-level design, which has resulted in several problems. The problems include a lack of coordination between departments, which causes cities to be built similarly, and the duplication of intelligent systems and intelligent construction. Local governments have diverse conceptions of smart cities, and there are differences in the overall framework design and various perspectives on smart cities. This has resulted in substantial investment funds and significant waste in some smart city construction [19, 20]. For example, many regions have deployed large amounts of information infrastructure in transport, energy, education, healthcare, and governance, but this does not form a holistic, organic smart city, resulting in imbalanced infrastructural, government, members, organizational, economic, and environmental systems [2]. Due to a lack of executive-level design planning and well-defined goals, the smart city's infrastructure is inadequate, and the construction operation model is monolithic. Currently, the government mainly makes investments and construction in China. The considerable investment risk makes enterprises and social capital reluctant to make investments when good policies are available [19]. In addition to the waste of resources, the inability to integrate resources without a clear plan has led to the problem of information islands, which is the most significant barrier to developing smart cities. The absence of uniform industry standards and the difficulty of converting and exchanging information between technical systems and government departments are additional issues.

3.2 Concerns about environmental protection

Maintaining a balance between people and nature, the concept of smart city development is to build cities sustainably, protect the city's ecological environment, and enhance the living environment of the city's inhabitants [19]. Environmental issues arising from rapid urbanization are a severe challenge to sustainable development. Although most of China's smart cities have set the goal of creating a smart ecology in their top-level designs, smart cities have not paid enough attention to or invested in the environment [2]. First, the ecological environment has been gradually deteriorating. The intelligence industry has not yet formed a green industrial chain. The phenomenon of heavy pollution and significant emissions from traditional manufacturing production has not been

effectively controlled. Second, the acceptance of green publicity among citizens is low, and environmental protection awareness has not been widely and sincerely accepted [19].

3.3 Low level of citizen participation and information privacy

The design of smart cities should take into account fundamental human needs. Although China is trying to integrate information technology into its residents' lives and improve public social services, the infrastructure in many cities is still in its infancy. It is difficult for the public to see the benefits of smart cities in the short term, resulting in low motivation and low participation [19]. In terms of technological advancement, certain technical applications are not yet fully established, resulting in widespread concerns. The state blindly pursues the latest technologies without considering the practical applications for citizens, wasting resources on some unwanted technologies. Some individuals, such as the elderly, are uncomfortable with QR code scanning and some WeChat mini-programs because they do not own smart devices or are struggling with adopting these applications. Although smart cities bring great convenience to people, the threshold of these brand-new apps excludes some people [4].

The issue of protecting the privacy of individuals and enterprises needs to be considered at this stage in China [20]. There are also ethical and information concerns associated with the use of technology, and the digital and intelligent expansion of cities has made cybersecurity a key issue [4].

4. Countermeasures and suggestions to promote smart city construction

4.1 Scientific planning and rational layout, increased investment

The creation of a smart city is a systematic construction project and coordinated planning should insist on national unification. To promote smart city construction [17], the central government should further develop fundamental and long-term top-level design programs [19]. At the national level, policy guidance should be made to determine the focus and critical areas of future development. Local governments should consider the actual situation and look for their unique construction and development paths to plan rationally. In addition, they should avoid blind investment and repeated construction by defining regional development objectives and directions, optimizing regional spatial structures, and closing regional development gaps.[18]. A smart city's core and key resource is information technology. Good infrastructure construction is needed to promote smart cities. In the infrastructure construction required for information technology, the government should take the lead, implement projects at the grassroots level, encourage social participation in multiple directions, advocate increased cooperation between government and enterprises, and stimulate joint construction by multiple parties [17]. The government is also the supervisor and auditor of smart city construction. It must pay attention to all aspects of risk prevention during project declaration, establishment, implementation, and operation, as well as whether the long-term cash flow of enterprises can meet the needs of the entire project cycle [20].

4.2 Implementing the concept of sustainable development

As for countermeasures for environmental problems, firstly, governments need to build a fundamental policy concept of green, low-carbon, and ecological protection and put it into practice. Secondly, enterprises should be bold enough to take social responsibility and incorporate the idea of green protection throughout their production and operation process [19]. Meanwhile, businesses must strengthen their science and technology and boost their Internet of Things-related scientific research activities. As the Internet of Things enables interaction with everyday physical objects, it can help to detect a healthy and safe living environment. Detection is vital to avoid health problems caused by environmental pollution. Companies can work with the government to develop a system that can effectively collect and analyze ecological data to avoid potential risks.

By comparing China's research with foreign smart cities regarding environmental governance and sustainable development, China can identify its strengths and weaknesses and learn from its country's

achievements and strategies in this direction. Finally, green concepts should be embedded in civic education and employment.

4.3 Introduction of public participation and protection of information privacy

Public participation refers to the process by which the public participates in the different stages of a smart city through various legal ways, expressing their needs and thus influencing policy formulation. At the planning stage, the public's needs can be understood by establishing committees to incorporate the public's needs into the design planning of a smart city. During construction, media updates can be used to inform the public about what is being built and its progress [21]. For the elderly who do not have access to smart products such as mobile phones, surveys can be conducted offline to engage them with their opinions and ideas. It is suggested that departments be created to routinely contact these neglected individuals.

Building smart cities generate vast amounts of data involving the private information of the state, society, enterprises, and people. Information security is one of the primary issues to be addressed. Firstly, the state should introduce legal policies and specify the relevant departments for legal constraints and guidance according to the actual situation of different cities [20]. Secondly, the state should consider using encryption, desensitization, and clear privacy boundaries. Lightweight encryption has become an essential requirement for the application of cryptography in practice and using public key encryption schemes or homomorphic encryption can desensitize data. The decentralized nature of blockchain can safeguard the interactions of smart city devices and increase the system's dependability and efficiency [1]. In addition, biometrics, game theory, and fog-based systems are also protection mechanisms and strategies that smart city builders can consider [1].

5. Conclusion

This paper reviews the domestic and international literatures, using the establishment of Chinese smart cities as a case study. It explains the Chinese smart city scenario and summarises the history and features of Chinese smart city policies, as well as the principal strategies executed in China to date. China's smart city mainly presents a top-down construction model intending to modernize the governance system and governance capacity. With this model and a series of other strategies, China's smart city has achieved a series of results after more than a decade of development. At present, some problems have emerged that the government and smart city builders need to consider. China's smart city lacks an overall top-level design. Many cities have blindly built smart cities because of top-down strategies that do not incorporate actual local needs, leading to construction and operation models. The lack of effective implementation of sustainable development and green concepts in smart city construction. The limited public participation and lack of privacy protection mechanisms. This paper also contributes some countermeasures to these problems. As for governments, they should build a long-term top-level design. Among different cities, the central government can cooperate with local governments to make investments regarding each city's characteristics, avoiding resource waste. Governments should also broaden sources of financing and monitor every project. As for enterprises, they should collaborate with the government to participate in smart city initiatives. They are increasing technological innovation, particularly in data security and sustainability. People should discuss green concepts and communicate their needs to government agencies to increase public participation. The shortcoming of this paper is that it only reviews and analyses the previous literature without conducting an in-depth study. Secondly, this paper is too broad in scope as it takes the whole of China as a case study. The descendants could be concerning the sub-segments of smart cities in China.

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