Development Strategies of Smart City Construction Based on PEST-SWOT Analysis

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Abstract. In this study, the PEST-SWOT model was adopted to analyze how to construct a well-developed smart city. Based on data from the National Bureau of Statistics and industry reports, we found that smart city construction is faced with threats such as a lack of overall planning and experience, narrow financing channels, data security issues, information islands, and the scarcity of talent. It follows that efforts should be made to resource guarantee, technology improvement and talent construction. Last but not least, it is high-quality and sustainable development that we should pursue in building smart cities.

Keywords: smart cities · PEST-SWOT model · strategies

1 Introduction

With the rapid expansion of global urbanization, people living in cities have to face "big city diseases", such as housing shortages, stressful work environments and high survival costs. Under these circumstances, all countries have intensified efforts to build smart cities via information technology and IoT so as to improve the governance system and management level [1]. However, many difficulties hinder the development of smart cities and the existing research pays less attention to the influencing factors and environment. Therefore, it is necessary to clarify driving factors and find out internal and external factors that influence the development and management of smart cities to reach targeted strategies.

2 Methodology

PEST analysis accesses the political, economic, social and technological factors in the external macro environment. Although the external environment cannot be changed, the organization can formulate appropriate development strategies to adapt to it [2]. SWOT matrix is a strategic management tool for comprehensive analysis of the environment, and its evaluation results help to match the internal resources and capabilities with the competitive environment [3]. Its components are shown in Fig. 1. Through a SWOT analysis of smart cities, the optimal development strategies can be formulated.
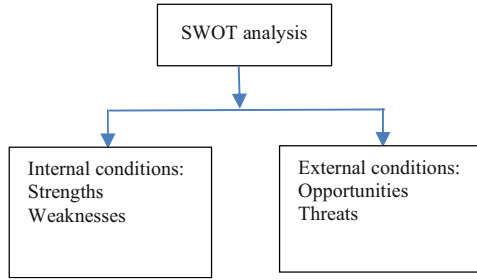
Fig. 1. Components of SWOT analysis

Fig. 2. PEST-SWOT analysis model

Since both of the above evaluate the external environment, this paper attempts to embed PEST into SWOT to build a PEST-SWOT composite analysis model (Fig. 2). The model can help decision-makers solve problems in a comprehensive and systematic way by integrating internal and external factors. In addition, smart cities have been actively promoted by the Chinese government. The success of their construction is related to the external environment and themselves. Therefore, urban resource elements can be rationally arranged by using the PEST-SWOT model to comprehensively analyze the macro environment, which will greatly improve the development quality of smart cities.

3   PEST-SWOT Analysis

The environment and characteristics of smart cities can be clarified via the PEST-SWOT model, conducive to identifying development strategies.

3.1   Comprehensive Analysis of External Opportunities

Politics
In terms of politics, China has continuously strengthened relevant support. In February 2006, the State Council issued the Outline of the National Medium- and Long-Term Science and Technology Development Plan (2006–2020), which first proposed the importance of developing digital cities and provided policy guidance for the subsequent construction of smart cities. Since then, a range of policies (Table 1) have been issued to promote the healthy development of smart cities.

Economy
The economic environment continues to improve, providing solid financial support for

Table 1. Policies regarding smart cities

Time	Policy	Content
2006.2	Outline of the National Medium- and Long-Term Science and Technology Development Plan (2006–2020)	Establish an efficient, multi-functional and integrated urban integrated management technology system
2012.11	Interim Measures for the Administration of National Smart City Pilot	Actively carry out the smart city construction and improve urban management capacity and service level
2016.2	Several Opinions on Further Strengthening the Management of Urban Planning and Construction	Realize orderly construction, proper development and efficient operation of the city
2018.2	Notice on Accelerating the Pilot of the New Generation National Traffic Control Network and Smart Highway	Accelerate the construction of intelligent transportation system to make urban traffic more orderly and safer
2019.1	Technical Outline for Construction of Smart City Spatiotemporal Big Data Platform	Build a spatiotemporal big data platform to promote the development of cities
2021.3	The 14th Five-Year Plan for National Economic and Social Development of the People's Republic of China	Accelerate the pace of building a digital society, and promote urban and rural development with digitalization
2022.6	Guiding Opinions on Strengthening the Construction of Digital Government	Promote the digital transformation of urban public infrastructure

smart cities. Smart city construction has developed rapidly in China despite of late start. Therefore, the past investment data is no longer of practical significance. Based on this, this paper focuses on the rapid development stage of China's smart cities (2016-now) [4]. During the 13th Five-Year Plan period (2016–2020), China's GDP increased from 68.89 trillion yuan in 2015 to 101.36 trillion yuan in 2020 (Fig. 3), with an average annual growth rate of about 9%. Steady economic growth is conducive to increasing financial investment and providing sufficient financial support for smart cities. As shown in Fig. 3, the investment scale increases with the growth of GDP.

Society

Smart cities are inseparable from the people living inside. For one thing, the increase in urban population is the fundamental reason for smart city construction [5]. Residents have been concerned about urban problems, such as housing shortages, stressful work environments and high survival costs. With the continuous growth of the urbanization rate and urban population (Fig. 4), those problems have become increasingly prominent, bringing serious challenges to urban managers. This forces cities to upgrade to meet the growing needs of citizens.

For another, with the progress of urban modernization, more and more smart services will be popularized (Fig. 5). Relevant research shows that smart cities can improve the efficiency of government work, reduce traffic congestion, optimize the allocation of
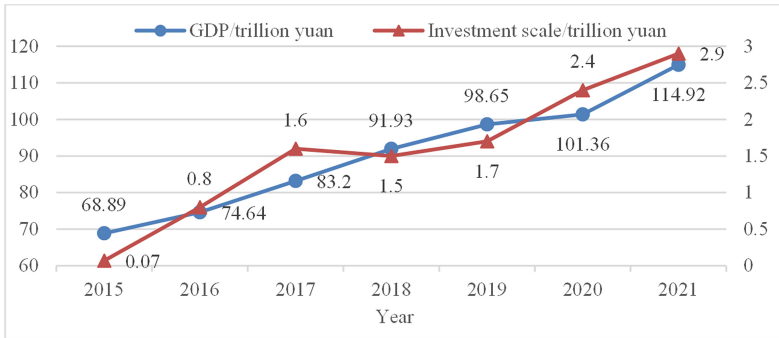
Fig. 3. Trend of GDP and investment scale (Data source: National Bureau of Statistics)
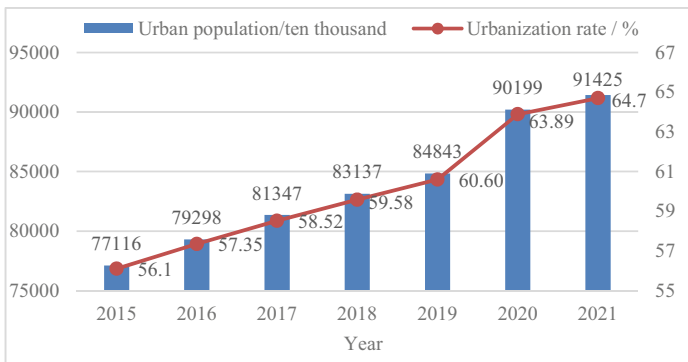

Fig. 4. Urban population and urbanization rate (Data source: National Bureau of Statistics)

educational resources, and ultimately improve the subjective well-being of residents by a large margin [6].

Technology

The progress of technology continues to optimize the infrastructure of smart cities. Basically, smart cities are in the advanced stage of urban informatization [7]. With the
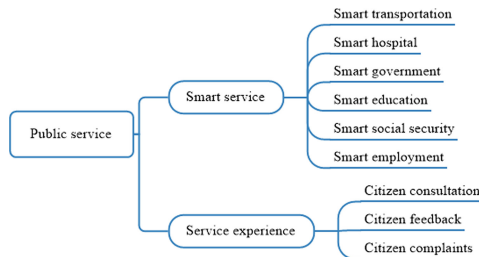

Fig. 5. Future public service (Data source: China Software Testing Center)
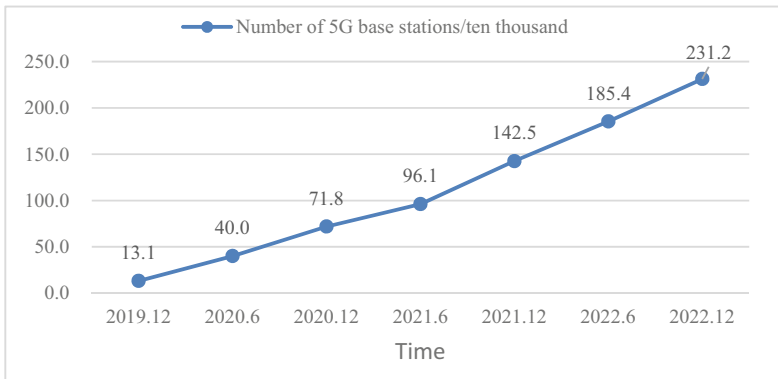
Fig. 6. Number of 5G base stations (Data source: www.askci.com)

progress of information technology, urban informatization has developed from the electronic city to the current smart city. As is known, China's rapid development in 5G technology has provided a solid foundation for sustainable development. 5G technology can be integrated into all aspects of smart city construction, providing application solutions for smart government, smart medical care and other aspects [8]. By the end of 2022, 2.312 million 5G base stations, accounting for more than 60% of the world's total, had been built in China (Fig. 6), with all prefecture-level cities covered, showing China's leading position in the world.

3.2 Comprehensive Analysis of External Threats

Politics

Although the central government has always placed a premium on the construction of smart cities, it has not yet rolled out a specific construction plan at the national level [9]. Most of the policies issued only provide principled and directional guidance for the application of relevant technologies. The lack of overall planning has led to blind and repetitive construction in various places, resulting in a waste of resources and one-sided development. Adding insult to injury, a handful of local governments view smart city construction as a political achievement, while ignoring the tangible needs of the people.

Economy

Inadequate participation of social capital and narrow financing channels are major problems in terms of the economy. In China, the construction of smart cities started late and its financing channels are narrow [10]. Compared with traditional urban infrastructure investment, smart city construction is faced with a long return period, unclear expected return and high investment risk. These issues have dampened the confidence and enthusiasm of investors and prompted some to pull back. Therefore, in the long-term process of smart city construction, the relevant expenditures are mainly borne by local finance, and the participation of social forces is limited. In this case, the capital flow lacks stability,

which limits the speed and quality of smart city construction and hinders sustainable development.

Society
In the daily life of citizens, information security management is not in place. Increasing network risks reduce life quality and work efficiency seriously. The behavior of residents is generating data all the time, and the construction of smart cities necessitates an enormous amount of data exchange and sharing. These data include sensitive information such as personal identity information, traffic trajectory, and public service use records. If such information is obtained or used by an unauthorized third party, it may cause serious privacy disclosure and personal information security problems. These threats may cause social distrust and panic, and then reduce the support and enthusiasm of the public.

Technology
It is technically difficult to realize the sharing and integration of information resources, and the phenomenon of data islands is common. The integration of resources, especially information resources, is the key to the construction of smart cities. However, the problem of data sharing has not been effectively solved with the emergence of data platforms. It is difficult to realize the flow of data between departments due to the lack of standard systems, nonuniform data format and limited data conversion. What's more, each system has a large and complex amount of data. The integration of multiple systems will undoubtedly increase the complexity of data processing, which requires more powerful data processing capabilities.

3.3   Analysis of Internal Strengths

First of all, the demand for intelligent construction is clear with huge market potential. According to statistics, the per capita consumption expenditure of urban residents increased from 21,392 yuan to 30,307 yuan and the Engel coefficient of urban residents dropped from 29.7% to 28.6% from 2015 to 2021. With the growth of consumption level, the residents' demand for smart cities is increasing, especially for sound public services and favorable living environments [11]. For example, city residents hope that smart cities can provide more convenient smart transportation and more diversified cultural services, revealing the strong growth of the market of smart cities.

Secondly, the sufficient endogenous power of smart city construction is conducive to sustainable development. With the deepening of smart city construction, many manufacturers have expanded from a single business to the entire industrial chain, helping to bring about a smart city industrial ecosystem. This trend promotes the optimal allocation of resources and sustainable development of smart cities. At the same time, the industrial ecology is attractive to the majority of marginal manufacturers to develop a business around it, thus realizing the expansion and extension of the industrial ecology itself.

3.4   Analysis of Internal Weaknesses

Problems and deficiencies lie in China's smart city construction due to late start and inexperience. First of all, smart cities in China are still in the stage of trial with cognitive

misunderstandings. For example, most cities hold that the construction quality depends on the technical level of the city. The technology-oriented construction may eventually deviate from the original intention of creating better urban life for residents, resulting in a huge gap between construction and actual demand.

Secondly, the talent shortage is another weakness. A smart city is a comprehensive system involving many elements. Each part has its own operating system and management mode in need of talents with different technical skills. In addition, the construction of smart cities cannot do without continuous iteration and upgrading of technology, which requires talents to learn and progress to keep up with up-to-date technology, otherwise, it may lead to technical bottlenecks. As a result, China is facing a shortage of talent despite having a large pool of talent.

4 Development Strategies

Based on the PEST-SWOT model, development strategies are proposed from aspects of resource guarantee, technology improvement and talent construction through the above comprehensive analysis of the macro environment, internal strengths and weaknesses of smart cities.

4.1 Resource Guarantee

Strengthening resource security is an important means to cope with external threats and overcome internal disadvantages. It highlights the necessity for governments to encourage all social sectors and strengthen policy guidance by establishing a collaborative mechanism involving all parties to give full play to their strengths. Each performs its own functions. Specifically, with policy support, capital investment and project evaluation from governments, enterprises play their role in technical support and business models, academic institutions remain committed to scientific research and technical consultation, while social organizations encourage public participation and conduct supervision.

In addition, governments should broaden the sources of financing and establish a long-term operation mechanism of funds. Social capital should be encouraged to reduce the capital pressure on governments. It is necessary to establish a benefit distribution mechanism for smart city construction involving multiple parties. This mechanism can help social subjects define their own scope of construction, responsibilities and benefits. As a result, the foundation of cooperation between all parties can be consolidated to enhance their investment confidence.

4.2 Technology Improvement

Technological innovation is the cornerstone of smart city construction, and informatization is the core of a smart city. Smart cities should break new ground in information technology to bring advantages into full play and solve development problems to the greatest extent [12].

It is crucial to strengthen the integration of information resources to deal with information islands. Three ways are as follows. The first is to establish an applicable technical

standard system and optimize it continuously to cope with shorter technology replacement cycle. The second is to develop and promote standardized technology to interconnect information systems. For example, promoting XML (Extensible Markup Language), SOAP and other technologies can improve the interoperability of information systems. The third is to give full play to the city's advantages and establish an information-sharing platform and a database. In this way, residents, enterprises and governments can all be on the same network, thus improving the efficiency of data application.

4.3 Talent Construction

Talent is an important force in the construction of smart cities. Some scholars believe that smart city construction requires not only talents with core technology creation ability, but also those strong in management and coordination as well as a top design [13]. Talent construction should be enhanced for the sustainable development of smart cities.

Governments should focus on building research universities, a base for talent training, to cultivate high-end comprehensive talents. Preferential policies can be issued to support scientific research, school-enterprise cooperation and talent introduction. Besides, the teaching system of universities should be consistent with educational philosophy, development strategies and market demand.

5   Conclusion

By analyzing the status quo of smart cities through the PEST-SWOT model, it is found that on the one hand, many opportunities and strengths fuel the development of smart cities including policy support, economic development, social needs, technical progress, huge market potential and enough endogenous power. On the other hand, they are faced with such threats and weaknesses as a lack of overall planning, narrow financing channels, information security risk, data islands, insufficient experience, cognitive error and talent shortage. In order to promote high-quality and sustainable development of smart cities, it is necessary to encourage all social parties to get involved and diversify financing channels to strengthen resource security, facilitate technological innovation and strengthen talent construction.

With economic development and expanding urbanization, smart city construction will be the development direction of more and more cities. It bears great significance to analyze the status quo of smart city construction in China and propose appropriate development strategies for reference.

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