

Development of Smart City Policies in First-tier Cities in China

Mingqing Yin ^{1,*} and Sutee Anantsuksomsri ^{1, 2}

1 Department of Urban and Regional Planning, Faculty of Architecture, Chulalongkorn University, Thailand

2 Regional, Urban, and Built Environmental Analytics, Faculty of Architecture, Chulalongkorn University, Thailand

**Corresponding author. E-mail: 6378010825@student.chula.ac.th
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ABSTRACT

To explore the policy tools to study the smart city policies in Chinese first-tier cities, which can help to promote the direction of smart city management. This research adopts a quantitative textual analysis method to collect relevant policies of Chinese first-tier cities from 2010 to 2021, and constructs a pilot analysis of smart city policies from supply-based, demand-based, and environmental perspectives by using Nvivo literature coding software. The results of the research show that local governments should strengthen the integration and sharing of information resources, improve the management of smart city industry chain, optimize the management mode, eliminate digital barriers, and realize the transformation from traditional management to smart management on the basis of strengthening information security measures.

Keywords: Smart city policy, Quantitative text analysis, Urban strategies, Policy analysis tools

INTRODUCTION

Urbanization is a double-edged sword, with 80% of global GDP coming from total urban economic production and only 20% from rural areas (Samita, 2019; Shanghai Municipal Commission of Economy and Information, 2020). Urbanization has entered a transitional phase. Global urbanization will reach 68.4 percent by 2050 (United Nations, 2018), while more than half of the world's current population lives in urban areas, according to a United Nations study. According to the United Nations, urban areas will account for 66% of the global population by 2050. (United Nations, 2014).

Many countries have experienced a series of problems due to the development of urbanization. According to official statistics, the urbanization rate of Asian countries is higher than that of European countries. In particular, China has entered a transitional period of urbanization and construction. With the rapid growth of first-tier cities, urban clusters have emerged. The total population of the five major urban clusters in China occupies 50-60% of the total population of any of the countries. This affects the increase in population density and thus the distribution of urban resources, as well as the uneven urban development of the surrounding areas. Especially, the urbanization rate of China's resident population will increase to 72% in 2030 (Samita, 2019). Although remarkable achievements have been made in urban construction, due to the rapid expansion of the urban population and the rapid expansion of urban scale, problems such as traffic congestion, lack of resources, and environmental pollution have become increasingly prominent, and social risks caused by governance problems have also increased.

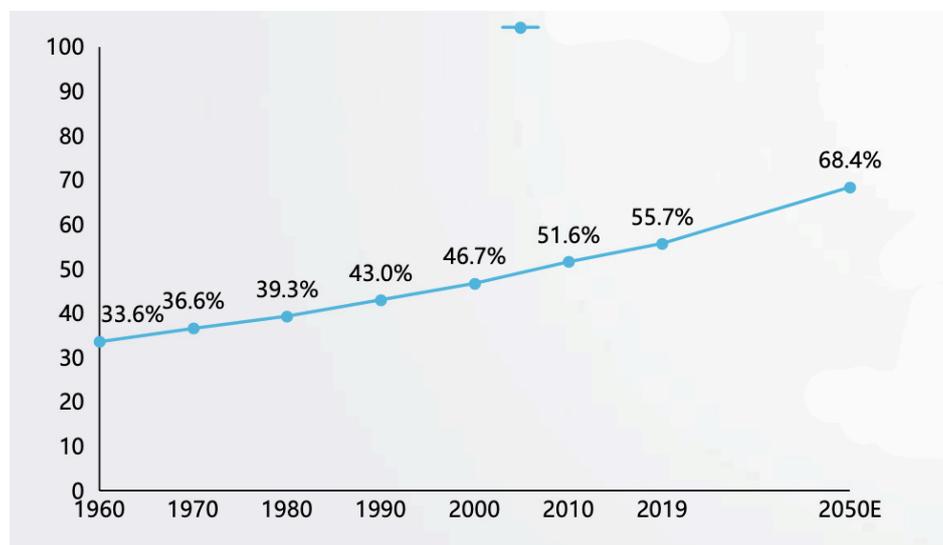


Figure 1. Global Urbanization Level and Development Forecast 1960-2050.

Source: United Nations. (2018).

LITERATURE REVIEW

Concept of smart city

According to the concept of smart city, smart cities rely on a new generation of information technology to achieve the purpose of resource integration, service optimization, and efficient governance in the urban construction and operation system, and ultimately use technology to meet the public's desire for a better life and the potential of the city (Caragliu et al., 2011). The definition of 'smart city' is still vague internationally, and it is accompanied by urban development planning and policy. In recent years, however, the concept of smart cities has come to represent more broadly the impact of advanced technologies on city management, governance, economies, and everyday life (Sagi, 2016).

China ranks the first in the world in the number of smart cities under construction. According to statistics, China has launched more than 500 smart cities and other related pilot projects. The Super Smart City Report found that the number of smart cities in China is much higher than that of the second European country in the world, and has become a smart city cluster in the Yangtze River Delta and the Pearl River Delta. Therefore, there is enough case data and reference value for China's smart city research (Deloitte, 2020).

Smart city development

The "Guiding Opinions on Promoting the Healthy Development of Smart Cities" propose that by 2020, China will build a group of smart cities with distinctive features, to greatly enhance the role of aggregation and radiation and significantly improve comprehensive competitive advantages. Remarkable progress has been made in terms of social management innovation and network security. In 2015, China's smart city construction has made great progress under the strong promotion of national policies covering Made in China 2025, smart medical care, smart transportation, the Internet, big data, cloud computing, etc.

In terms of smart city theory in China, the "smart" in the concept of "smart city" should focus on intelligence, while "wisdom" focuses on spirituality and human culture. Since the concept of smart city was introduced in China in 2009, the concept of smart city is still in the discussion stage. Due to the different knowledge backgrounds and perspectives of each concept proposer, different definitions of the concept of "smart city" have been formed. But they have their commonalities and intersections. That is, these concepts all hold the idea of using a new generation of information technology to achieve sustainable urban development and improve the quality of life of residents (Khansari, Mostashari, & Mansouri, 2013). Smart cities can be developed in two ways: "top-down" or "bottom-up". The difference between Chinese and foreign smart cities is that foreign smart cities are driven by technology to achieve sustainable urban development. The connotation of smart cities in China believes that information technology is only a means of urban development, and the research on smart cities should pay more attention to the overall development and operation of cities and the humanistic perspective of "people-oriented". The definition of the scope of smart city policy should be integrated into the policy of smart city construction (Luterek, 2020).

The growing demand for smart city construction has become China's response to the economy. Downward pressure and the highlight of promoting the "Internet +" strategy In December 2015, the Central City Work Conference made specific arrangements for doing a good job in urban work, pointing out that it is necessary to grasp the "locomotive" of the city, promote a new type of urbanization with people as the core, and strive to build a smart city; cultivate and develop in the central and western regions (EO Intelligence, 2020). The coordinated development of urban agglomerations, regional central cities, and port cities will be approved. At present, the construction of smart cities in China has entered a peak period, and the construction of smart cities has become an inevitable trend in urban development in China and a strategic commanding height to promote new urbanization.

Big data is the key to smart city construction and the center of smart city construction. China's first-tier cities are national big data demonstration bases, and

the big data industry has become the core strategy for economic and social development. The scope of this research is limited to China's first-tier city clusters for the following reasons: China's smart city projects are number one in the world with more than 500 smart city projects (Deloitte, 2020).

Smart city policy

Regarding smart city policy on a global scale. With the advancement of the world's smart city construction process in recent years, smart city policy, as an important field of smart city research, has become the focus of academic attention. Foreign scholars' research on smart city policy mainly focuses on the perspectives of policy function, policy development and policy evaluation of smart cities. Smart city policy innovation is an important factor affecting the development of smart cities, and it is a balance between demand-driven and supply-driven approaches (Nam & Pardo, 2011). Smart city policies of various countries and believed that different types of cities should make policy choices based on their conditions and development needs. Compared with foreign research on smart city policy, domestic scholars pay more attention to smart city policy (Angelidou, 2014).

In terms of smart city policy in global level. The United States, Australia, the European Union, and other countries, regions, and international organizations have carried out a large number of explorations in building smart cities and issued a series of relevant policies with distinctive features to encourage the construction of local smart cities. Following the pace of smart city development in these countries and regions, China has also set off a wave of smart cities and smart projects. However, many problems have arisen during the implementation of smart city policies. This includes management issues, investment and construction issues, and operational technical issues. Indeed, smart cities are the first choice for solving urban development problems.

In the smart city policy concept, they should adhere to the concept of sustainable development and should build multiple goals (Xu, 2021). Citizens can see a picture of how you want to see the city grow in the future. It's important to make sure that information technology and industrial development, government governance, and urban development are all included in policy making, from the perspective of social subjects. This way, citizens can avoid the problem of separating policy design from real needs to a certain extent (König, 2021).

In China, a large number of scholars have tracked the intensity of policy concepts and compared the structural differences of smart city policies in different regions, different periods, different administrative levels, and different policy types. They believe that China's smart cities are reflected in the strength of policy concepts and the structure of policy concepts. high consistency and similarity (Tang et al., 2020; Xu, 2021). Huang (2014, 23p-33p) proposes the smart city policy presents two policy concept orientations of technology and humanities and has formed two basic cognitions of the city of "city-centered" and "people-centered" in policy discourse. The top-level design of the city should include infrastructure, management services, smart industry and a supportive environment. The construction capacity, development, level and development potential of smart cities are evaluated ted by policy. To promote the construction of smart cities, we must correctly handle the relationship between the "invisible hand" of the market and the "visible hand" of the

government, drive technological innovation and financial innovation, ensure information integration, sharing and interconnection in infrastructure construction, and pay attention to technical specifications. and legal norms, and comprehensively promote it based on accumulated experience in typical demonstrations, to create a good policy environment for the construction of smart cities (Huang & Yuan, 2014).

However, the formulation of urban development policies lacks consideration of the actual situation, and there is no effective information sharing and cooperation mechanism between neighboring cities. Even though the smart city policy system has begun to take shape, local governments lack targeted and directional policies based on local characteristics and actual development when formulating policies, and the problems of blind construction and lag in institutional mechanisms still exist. There are also a lot of challenges in the smart city operation model. The operation of the public-private partnership (PPP) mechanism lacks the guidance of laws and regulations, and the government lacks effective supervision of private enterprises, resulting in the abuse and waste of R&D costs. Smart city policies play an important role in smart city construction, but the policy system needs to be improved (Zhang, 2020). Therefore, it is necessary to provide differentiated and perfect suggestions for smart city policies in different regions.

As Chinese scholars propose that many issues have emerged throughout smart city implementation. Including management, investment, and construction during the operation of smart city projects. So that this research explores and studies the current status of smart city development and local policy formulation issues, including smart city case studies and policy analysis. To understand the challenges and difficulties of smart city development, and to advise on policy formulation. The results of this research can be given to local cities in China as a reference for policy formulation, as well as other smart city projects in Asia and the world.

Although the above studies cover important issues of smart city policy, there is still a lack of research on smart cities from the perspective of policy tools. Research on policy tools is very necessary. Which policy tool to choose and which standard to use to evaluate the effect of the policy tool has a decisive impact on whether the government can achieve the established policy goals. From the perspective of policy tools, this paper takes the policy of smart cities in China's first-tier cities as the research object, explores the rationality of the use of policy tools in smart city policy plans, analyzes the existing problems and puts forward suggestions for improvement.

METHODOLOGY

This research analyzes smart city policies in first-tier cities in China in order to understand the current status and challenges of smart city policy development and to provide targeted recommendations. Therefore, the research questions and research scope as follows:

Research Question

- What is the smart city policy in China?
- What are the challenges of smart city policy in China?

Research Scope

In total, the research selects policies from the central government and first-tier cities in China, including Beijing, Shanghai, Guangzhou and Shenzhen, as the scope of this research. The total number of collected is 66 policies. Through the Peking University Law website (<https://www.pkulaw.com>). Searching the notional-level and city-level laws and regulations on smart cities with the year filtered from 2010 to 2021. The website is a database of Chinese laws and regulations built by Peking University, which is extremely rich in content and has been upgraded to a certain market share and is well received by domestic and foreign customers.

China's first-tier cities have concentrated talents and developed technologies. Talent and technology are the main forces for the diffusion of urban innovation. To stand out in the battle for talent, all provinces and cities in China have successively introduced attractive talent policies, trying to gather talents through favorable treatment and conditions (Shan, 2021). According to data from the U.S.-China Economic and Security Review Commission Report, more than 150 towns throughout the country have published talent plans since 2019, an increase of more than 40% over the same period in 2018 (Atha et al., 2020). The "talent competition" is attracting a growing number of cities. Therefore, to better understand the construction of smart cities in China, four cities or regions with typical significance are selected as research cases, namely Shenzhen, Shanghai, Beijing, Guangzhou, and Shenzhen.

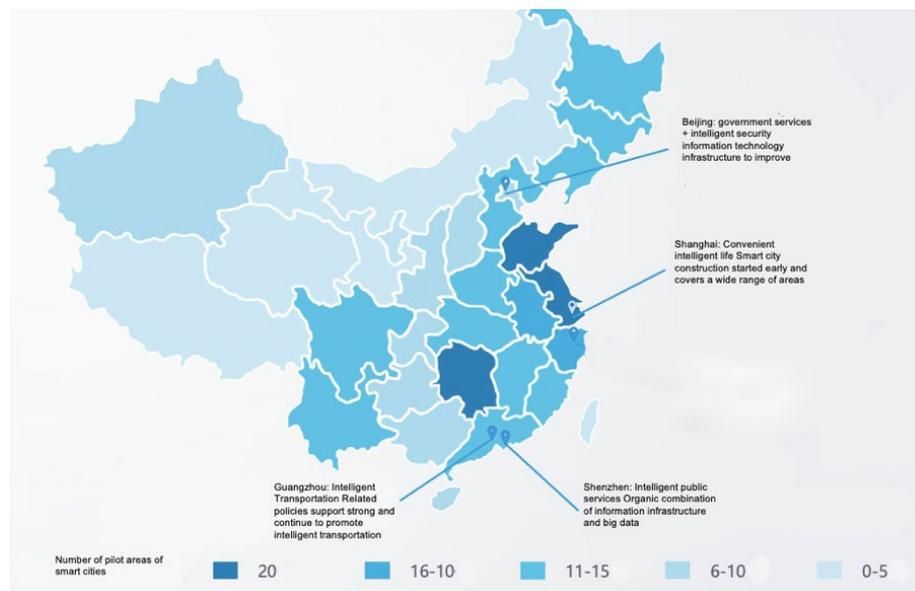


Figure 2. Distribution of Smart City Pilot Areas in China.

Source: (Atha et al., 2020)

Analysis Method

In the research of policy analysis tools, most of them focus on the evaluation of smart city policy effects and the coding statistics of policy tools, and the theory of policy tools has been widely used. Most scholars use the content analysis method to document statistical analysis of smart city policy texts. At the national policy level, scholars have found that China's smart city policy highlights the main role of the

government through the coding and statistics of policy texts and policies while taking into account the use of regulatory policies and incentive policies (Huang & Yuan, 2014). Policy analysis should be analyzed from the five dimensions of policy quantity, text form, policy issuing department, policy theme, and policy tool. Smart city policy has problems such as excessive use of mandatory policy tools, low legalization, insufficient market mechanism, and insufficient participation of social forces, and put forward suggestions for improvement in response to the above problems.

Policy tools into three types: Supply-based Policy Tools play a driving role in the construction of smart cities, Demand-based policy tools play a pulling role, and Environmental-based policy tools play an indirect role (Lin et al., 2017).

The analysis process in this research used quantitative analysis of textual content as the main research method and was coded by Nvivo software. The specific coding dimensions were adopted as the research dimensions of policy instruments, which were Supply-based, Environmental-based and Demand-based (Huang & Yuan, 2014; Sun et al., 2016). Further, the different policy instrument dimensions were refined and categorized through the coding process, which can be referred to the classification method in Table 1. Thus, the 66 policy texts were coded in full text to understand the main contents of the First-tier city smart city policies.

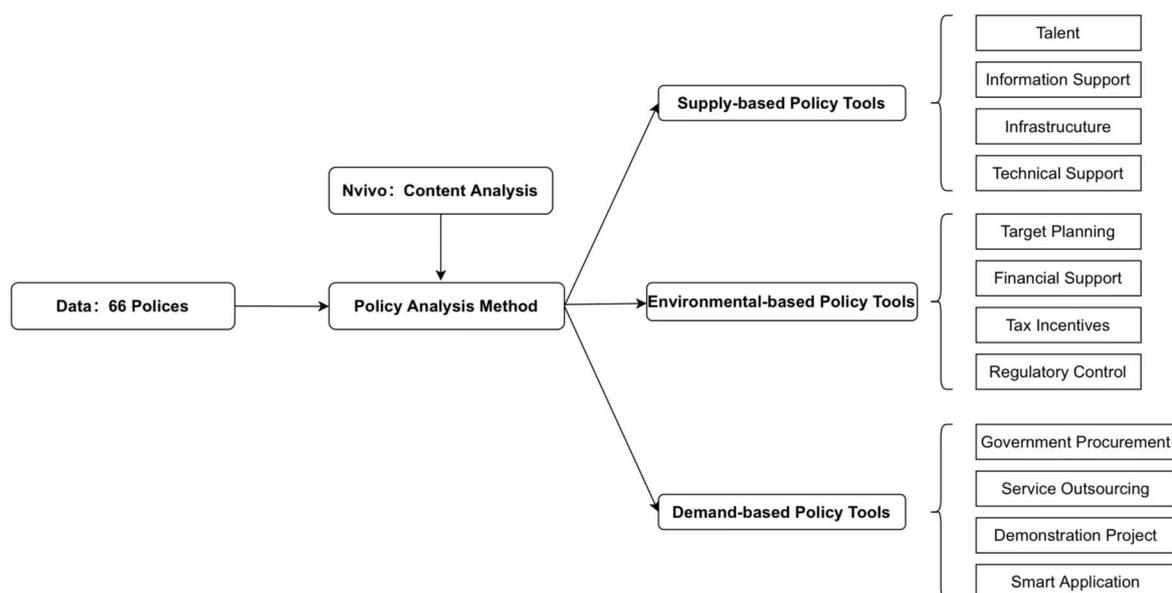


Figure 3. Policy analysis method

Source: Made by author

The supply-oriented policy tool is the government's investment in talents, technology, capital, information and other aspects to ensure the supply of basic elements required by the government to promote the construction of smart cities. Supply-oriented policy tools can be subdivided into talent input, information support, and infrastructure construction.

Environmental policy tools are used by the government to indirectly affect the construction of smart cities using regulations, finance, taxation and other measures, and provide a favorable development environment for them. Environmental policy tools can be further subdivided into target planning, tax incentives, Regulations, etc.

Demand-based policy tools are more manifested as the driving force of policies to the construction of smart cities, which means that the government reduces market uncertainty by purchasing services and contracting abroad, so as to ensure a relatively stable environment for the development of smart cities. Demand-based policy tools can be further divided into government procurement, service outsourcing and other aspects.

Table1. Classification of policy tool.

Supply-based Policy Tools	Environmental-based Policy Tools	Demand-based policy Tools
Talent	Target Planning	Government Procurement
Information Support	Financial Support	Service Outsourcing
Infrastructure	Tax incentives	Demonstration Project
Technical Support	Regulatory Control	Smart Application
Others	Others	Others

Source: Lin et al., 2017

This research uses the content analysis method to encode the policy text. First, the Nvivo software is used to screen the core word frequency of the policy text, and the words and associated words with a word frequency less than 5% are directly eliminated, and then the core words of the text are determined. Afterward, the text is defined, and the tools are divided according to the taxonomy of policy tools. Then use Nvivo software to encode the policy tool type and specific tool according to the tree node and sub-nodes of the policy text.

In order to fully reflect the development process and status quo of smart city policies in first-tier cities, the policy texts selected for the case are mainly collected from the websites of relevant ministries and commissions of Beijing, Shanghai, Guangzhou, and Shenzhen, including various opinions, notices, suggestions, approvals, plans and other documents in different periods. After sorting and screening, 66 valid texts were finally selected (Peking University, n.d.)

Table2. Date of policies collection.

	Title	Potency level	Release department	Release date	Implementation date
1	Notice of the Ministry of Housing and Urban-Rural Development and the Ministry of Industry and Information Technology on Determining the Second Batch of Pilot Cities for the Coordinated Development of Smart City Infrastructure and Intelligent Connected Vehicles	Departmental Working Paper	Ministry of Housing and Urban-Rural Development; Ministry of Industry and Information Technology	2021.12.01	2021.12.01

	Title	Potency level	Release department	Release date	Implementation date
2	Notice of the Ministry of Housing and Urban-Rural Development and the Ministry of Industry and Information Technology on Determining the First Batch of Pilot Cities for the Coordinated Development of Smart City Infrastructure and Intelligent Connected Vehicles	Departmental Working Paper	Ministry of Housing and Urban-Rural Development; Ministry of Industry and Information Technology	2021.4.28	2021.4.28
3	Notice of the General Office of the Ministry of Housing and Urban-Rural Development on the Establishment of the Smart City Professional Committee of the Ministry of Science and Technology	Departmental Working Paper	Housing and Urban-Rural Development	2019.12.5	2019.12.5
4-65			...		
66	Announcement on National Standards of the People's Republic of China [2018] No. 13 - Announcement on Approving the Release of 23 National Standards and Foreign Language Versions of 46 National Standards including the "Guidelines for Smart City Information Technology Operation"	Departmental Working Paper	State Administration for Market Regulation; National Standardization Administration	2018.10.10	2018.10.10

Source: Peking University Law

Policy Text Encoding

By identifying the specific terms of the policy text, defining the policy tool category to which it belongs, using Nvivo software to build nodes and code the policy text. The specific operation process is as follows: first, import all 66 smart city-related policy texts into Nvivo software, and establish three tree nodes of supply-based tools, environmental-based tools and demand-based tools; secondly, under the tree node, according to the above policy tools Sub-nodes are established in

turn by the specific classification of the policy text; finally, the content analysis method is used to encode the specific clauses of the policy text line by line, and the words or sentences appearing in the text are classified under the corresponding nodes. The coding method is "policy number-specific clause". When all the texts are encoded, 267 codes are finally formed through the automatic statistical function of the reference points by Nvivo software.

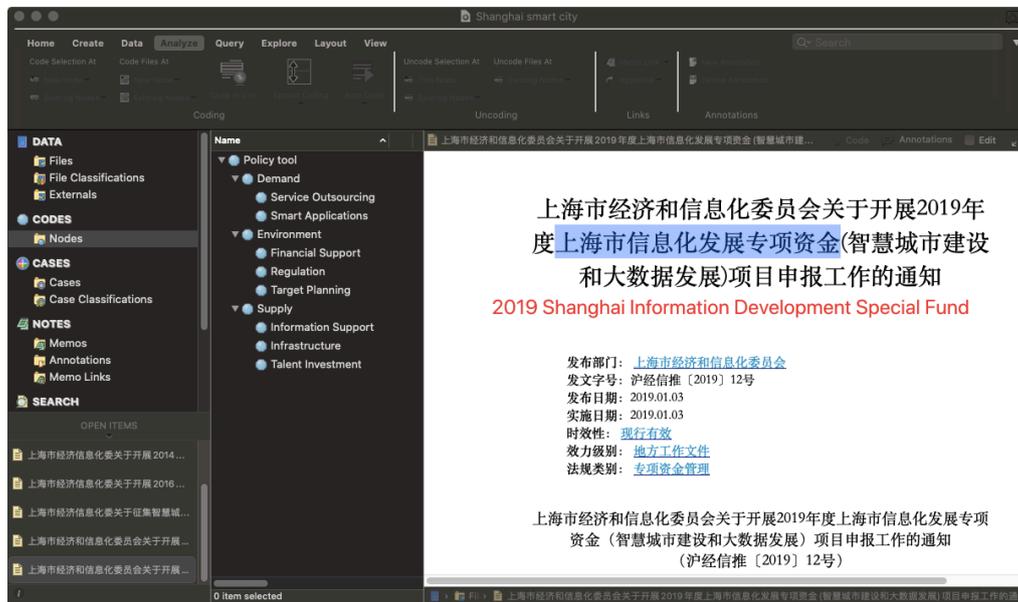


Figure 4. An example of NVIVO coding policy.

Source: Made by author

RESULTS

Smart city development in China

Chinese governments at all levels are also actively engaged in the practice of smart city construction and promote its implementation at the policy level. By the end of 2020, 100% of cities above the sub-provincial level, 95% of prefecture-level cities, and 20% of county-level cities will have launched the construction of smart cities (Shanghai Municipal Commission of Economy and Information, 2020).

As of November 2018, 14,249 smart city projects have been awarded to smart cities across the country, while a total of 12,162 smart community projects have been awarded. This includes municipalities directly under the central government, sub-provincial cities, prefecture-level cities, county-level cities, etc. The development of smart cities in first-tier cities plays a leading role for cities in central and western China. More and more are joining the ranks of those building new smart cities (EO Intelligence, 2020).

Smart city policy development

In China National-level policies, the National New Urbanization Plan (2014-2020) proposed to promote the construction of smart cities. In August 2014, the Guidance on Promoting the Healthy Development of Smart Cities was issued. 2

years later, in December 2016, the National Standards Committee issued the New Smart City Evaluation Index (Peking University, n.d.).

Concerning the first research question, local governments have formulated policy documents such as guidelines, development plans and action plans for smart cities at the first-tier city level, such as the "Thirteenth Five-Year Plan for Promoting Smart City Construction in Shanghai" and the "Beijing Municipal Working Group for the Promotion of Big Data" issued on March 5, 2021. The Notice on the Action Plan for the Development of Smart Cities in the "14th Five-Year" Period, the Announcement of the Guangzhou Municipal Bureau of Industry and Information Technology on April 1, 2021 on the Commissioning of the Guangzhou Smart Networked Vehicle Demonstration Zone Operation Center to Carry Out the Project of Promoting the Results of the Collaborative Development of Smart Networked Vehicles and Smart Cities in Guangzhou, and the Announcement on December 2020 No. 29 Shenzhen Municipal People's Government promulgated "Several Opinions of Shenzhen Municipal People's Government on Accelerating the Construction of Smart City and Digital Government", etc.

The policies of smart cities in China's first-tier cities to promote the development of smart cities cover supply-based, environmental-based, and demand-based policy tools, providing all-around encouragement and support for smart city construction. In the distribution of the use of these three policy tools, supply-based tools accounted for 34.6%, environmental-based tools accounted for 30.1%, and demand-based tools accounted for 35.3%. It can be seen that smart city-related policies use more environmental policy tools, and indirectly promote the development of smart cities by providing a favorable policy environment. However, in general, the use of the three policy tools is relatively balanced, which is conducive to smart cities. construction and development.

Table 3. The proportion of smart city policies in first-tier cities.

Type	Policy tool			Total 170 items
	Supply-based (34.6%)	Environmental- based (30.1%)	Demand-based (35.3%)	
Infrastructure (23.3%)	Encourage innovation (13.1%)	Smart Applications (70.4%)		
Talent input (24%)	Regulations (36.4%)	Service Outsourcing (4.9%)		
Information Support (10.8%)	Target Planning (24.3%)	Government Procurement (8.6%)		
Financial investment (26.4%)	Tax Incentive (11.2%)			
Others (17.3%)	Others (15.0%)	Others (16.1%)		

Source: Made by author

In terms of the distribution of the sub-items of the three types of policy tools, among the supply-oriented policies, the financial investment is the largest, with a total of 14 items, accounting for 26.4% of the supply-oriented policies; the second is the infrastructure, accounting for 23.3%; the second is the talents input, accounting for 24%. It can be seen that although the frequency of use of the three most commonly used methods is different, the difference is very small. In contrast, the strength of technical support and information support has weakened.

In environmental policy, regulation and target planning are the most commonly used tools. Regulations are the most frequent, with a total of 19 items, accounting for 36.4% of environmental policies, followed by target planning, accounting for 24.3%. Among the demand-based policies, smart applications accounted for the most prominent proportion, with a total of 42 items, accounting for 70.4% of the demand-based policies.

Finally, concerning the second research question, the use of supply-type and demand-type policy tools needs to be strengthened, and the driving force and pulling force for the development of smart cities are slightly insufficient. Among them, information support only accounts for 10.8% of supply-oriented policy tools, and the investment is insufficient. In the construction of smart cities, if there is a lack of information exchange between government departments and between the government and citizens, "information islands" will result, which will easily lead to unbalanced development of smart city construction.

Taken together, the content of smart city policies is vague and lacks details and standardized guidance recommendations. Specific industry standards, laws and regulations, and supervisory and regulatory measures for wisdom city application areas lack detailed descriptions. The Internet of Things, cloud computing, mobile Internet, big data and other new-generation information technologies as well as remote sensing, geographic information systems, satellite navigation and positioning systems and other spatial information technologies. However, the current policies related to the development of smart cities lack the constraints and standards of the technologies.

In addition, wisdom city policy development and implementation lack of clear management and supervision institutions. At present, policies related to smart cities are both issued by municipal governments and policies issued in the name of government economic information authorities. The lack of a unified information release platform and standardized process, the current policy release is more arbitrary.

At present, various municipal administrative departments on the development of smart city-related policies lack of regional level of information unity, smart city authorities set up a variety of situations: some set up a special smart city leading group and office, some in the industry and information technology department, some in the development and reform department, some in the housing and urban-rural construction, etc.

Policymaker is lack of macro vision and prediction of future trends for policy formulation. The relevant government departments of smart city policymaking lack coordination and linkage mechanism in the construction of smart city. The degree of legalization of smart city policy is low, the policy process is not standardized and transparent enough, and there is no active mobilization of social personnel and participation of experts and civil organizations from multiple parties.

DISCUSSION

Among China's first-tier cities' investment in smart city construction, environmental tools are the most used, followed by demand-based tools, and supply-based tools are used less. The frequent use of environmental policy tools

reflects that government departments attach importance to the construction of the external environment of smart cities and focus on relying on regulatory control, financial support, and other tools to create a healthy, orderly, and smooth legal and financial environment for the construction of smart cities in first-tier cities. Multi-faceted cooperation and coordination promote the rapid development of smart cities. However, the proportion of preferential tax policy tools is relatively low, indicating that the taxation methods of local governments are subject to the central government and the choice of tools is limited.

The driving force and pulling force for the development of smart cities still need to be improved. Demand-based policy tools are primarily a protective tool used in times of market uncertainty, industry downturns, or risks. From the perspective of the structure of demand-based tools, the proportion of smart application tools is relatively high (70.4%), indicating that under the background of "Internet +," the government has fully applied the new generation of information technology to all walks of life in the city to realize informationization, the deep integration of industrialization and urbanization. In the field of transportation, vigorously promote "Internet + car maintenance", "Internet + smart driving training", and "Internet + online car-hailing" to realize integrated transportation decision-making.

Among the supply-oriented policy tools, the government mainly affects the construction of smart cities through policies such as financial guarantees, technical investment, and large-scale resource supply. In the project's construction, the government directly plays a main role in the construction. The management of smart cities is still lacking. From the perspective of the industrial chain of smart cities, the government generally invests the largest scale in the initial construction of smart cities, while the emphasis on management and application has declined. The smart city is a massive system project with a long cycle and a broad scope. At present, the construction and operation of smart cities is still in their infancy, so the government still lacks experience in management, and the management method needs to be further optimized.

Improve Environmental Policy

Strengthen information security and strengthen the integration and sharing of information resources. Dealing with the relationship between information security and information transparency is an urgent problem that needs to be solved at present. The construction of a new smart city is inseparable from the central construction, development, and utilization of data, and problems such as the analysis and application of the whole chain of the big data industry and the imperfect ecological system also restrict the construction of new smart cities.

In addition, a lack of security experience and loopholes in security systems will also increase the vulnerability of the operation and management of new smart cities and even pose a threat to urban information security. Smart cities not only need to be based on the construction of various information infrastructures but also pay more attention to the sharing of various types of urban information, the mining and utilization of urban big data, and the construction and protection of urban security.

At the same time, with the increasing degree of urban informatization and intelligence, the issue of urban information security has attracted more and more

attention, and the construction of smart cities has also paid more attention to the construction of urban information security systems to ensure the security of various types of information and big data in the city. Therefore, it is necessary to strengthen the integration and sharing of information resources based on strengthening information security measures. In the process of smart city application, the boundaries of information opening and sharing should be clarified, and an information security system for smart cities should be built. The construction of relevant laws and regulations should be strengthened to standardize the behavior of information utilization.

Increasing demand-based policies

Deepening application services and building a shared smart people's livelihood service system. At present, the construction of new smart cities is no longer limited to the construction of information infrastructure and the promotion and application of information technology in-depth, but rather involves building smart cities from the aspects of improving the basic functions of cities, improving public service capabilities, and tapping the potential of urban development. In terms of breadth, the construction of new smart cities has been gradually extended to urban management, people's livelihoods, education, medical care, transportation, industry, and other fields.

Increase demand-based policies supply

Eliminate digital impediments and achieve smart management. The key to the construction of smart cities is to break down all kinds of information and data silos in traditional digital cities, realize the collection, sharing, and utilization of various urban data, establish a unified urban big data operation platform, and effectively play the role of big data in "good governance, benefiting the people". The development of a smart city is not a simple application of technology. It is based on the digital city, combined with the technology of the smart city, and integrated into the city's cultural feelings.

Clarify the standardization of smart city policy

Legalization and transparency level. Regarding the lack of laws and regulations, the focus should be on market supervision, public services and other areas to strengthen information sharing. Improve the standards in the field of smart city technology and implement quality supervision standards for the application of technology. Use big data technology to implement classification and grading supervision of market entities and scientific allocation of law enforcement resources.

Actively social participate

It should create a clear responsible department to coordinate and collaborate on the formation of departments at all levels at the municipal level and share information. uniformly responsible for the planning and management of the smart city. A smart city involves six aspects such as the economy, education, transportation, the environment, people's livelihood, security, etc. Therefore, the different collaborative work involved is complex, and the amount of information and management is difficult. The relevant parts should flexibly use the smart government system, combine with smart city-related research institutions and civil

organizations, promote social organizations, the public, and other social forces to participate in urban governance through the Internet, form a social governance situation, and realize the transformation from urban management to urban governance.

CONCLUSION

From the perspective of policy tools, through the statistical analysis of 66 texts of smart city policies in first-tier cities in China, we found that smart city policies in first-tier cities cover three types of policies: environment-based, demand-based, and supply-based policy tools. At the same time, there are different problems and challenges, such as a low degree of legalization and insufficient participation of social forces in smart city policies, and targeted improvement suggestions are proposed for these challenges.

This research enriches the perspective and content of smart city policy research and has positive significance for improving and optimizing the smart city policy system. In China's first-tier cities, smart cities have been developed with initial typicality and representativeness, and the study of smart cities in China's first-tier cities and other cities in China and other parts of the world has significance for participation.

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Appendices

	Title	Potency Level	Release Department	Release Date	Implementation
1	Notice of the Ministry of Housing and Urban-Rural Development and the Ministry of Industry and Information Technology on Determining the Second Batch of Pilot Cities for the Coordinated Development of Smart City Infrastructure and Intelligent Connected Vehicles	Departmental Working Paper	Ministry of Housing and Urban-Rural Development; Ministry of Industry and Information Technology	2021.12.01	2021.12.01
2	Notice of the Ministry of Housing and Urban-Rural Development and the Ministry of Industry and Information Technology on Determining the First Batch of Pilot Cities for the Coordinated Development of Smart City Infrastructure and Intelligent Connected Vehicles	Departmental Working Paper	Ministry of Housing and Urban-Rural Development; Ministry of Industry and Information Technology	2021.04.28	2021.04.28
3	Notice of the General Office of the Ministry of Housing and Urban-Rural Development on the Establishment of the Smart City Professional Committee of the Ministry of Science and	Departmental Working Paper	Housing and Urban-Rural Development	2019.12.05	2019.12.05

	Title	Potency Level	Release Department	Release Date	Implementation
	Technology				
4	Opinions of the State Administration of Cultural Heritage on the Construction Project of the Southwest Smart City Cultural and Creative Park within the Construction Control Zone of the Diaoyucheng Site	Departmental normative documents	State Administration of Cultural Heritage	2019.09.20	2019.09.20
5	Notice of the General Office of the Ministry of Natural Resources on Printing and Distributing the "Technical Outline for the Construction of Smart City Spatiotemporal Big Data Platform (2019 Edition)"	Departmental Working Paper	Ministry of Natural Resources	2019.01.24	2019.01.24
6	Announcement on National Standards of the People's Republic of China [2018] No. 13 - Announcement on Approving the Release of 23 National Standards and Foreign Language Versions of 46 National Standards including the "Guidelines for Smart City Information Technology Operation"	Departmental Working Paper	State Administration for Market Regulation; National Standardization Administration	2018.10.10	2018.10.10
7	Notice of the State Administration of Surveying, Mapping and Geographic Information on Accelerating the Pilot Work of Building Spatiotemporal Big Data and Cloud Platforms for Smart Cities	Departmental Working Paper	National Bureau of Surveying, Mapping and Geographic Information (former National Bureau of Surveying and Mapping) (cancelled)	2017.11.28	2017.11.28
8	National Standard Announcement No. 26 of 2017 - Announcement on Approving the Release of 425 National Standards including the "Smart City Technology Reference Model"	Departmental Working Paper	General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (canceled); National Standardization Administration	2017.10.14	2017.10.14
9	Notice of the Office of the National Bureau of Surveying, Mapping and Geographic Information on Printing and Distributing the "Technical Outline for the Construction of Spatiotemporal Big Data and Cloud Platforms in Smart City" (2017 Edition)	Departmental normative documents	National Bureau of Surveying, Mapping and Geographic Information (former National Bureau of Surveying and Mapping) (cancelled)	2017.09.06	2017.09.06
10	Letter from the Department of Land Surveying and Mapping of the National Bureau of Surveying, Mapping and Geographic Information on recommending the first batch of typical cases of smart city spatiotemporal big data and cloud platform construction	Departmental normative documents	National Bureau of Surveying, Mapping and Geographic Information (former National Bureau of Surveying and Mapping) (cancelled)	2017.06.26	2017.06.26

	Title	Potency Level	Release Department	Release Date	Implementation
11	Notice of the Office of the National Bureau of Surveying, Mapping and Geographic Information on Sending Staff to the United Nations International Symposium on Smart Cities and Sustainable Development	Departmental Working Paper	National Bureau of Surveying, Mapping and Geographic Information (former National Bureau of Surveying and Mapping) (cancelled)	2017.04.13	2017.04.13
12	National Standard Announcement No. 23 of 2016 - Announcement on Approving the Release of 292 National Standards and 23 Foreign Language Versions of the "New Smart City Evaluation Indicators"	Departmental Working Paper	General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (canceled); National Standardization Administration	2016.12.13	2017.07.01
13	Notice of the General Office of the National Development and Reform Commission, the Secretariat of the Central Cyberspace Administration of China, and the Office of the National Standards Commission on Organizing the Evaluation of New Smart Cities to Practically Promote the Healthy and Rapid Development of New Smart Cities	Departmental Working Paper	National Development and Reform Commission (including the former National Development Planning Commission and the former State Planning Commission); the Office of the Central Network Security and Informatization Leading Group (already changed); the National Standardization Administration	2016.11.22	2016.11.22
14	Notice of the Office of the National Bureau of Surveying, Mapping and Geographic Information on Holding a Work Meeting on the Promotion of the Construction of the Smart City Space-Time Information Cloud Platform	Departmental Working Paper	National Bureau of Surveying, Mapping and Geographic Information (former National Bureau of Surveying and Mapping) (cancelled)	2016.11.08	2016.11.08
15	Notice of the Department of Building Energy Efficiency and Technology of the Ministry of Housing and Urban-Rural Development on the Summary of the Development of Smart City	Departmental Working Paper	Housing and Urban-Rural Development	2016.05.26	2016.05.26
16	Notice of the Department of Building Energy Efficiency and Science and Technology of the Ministry of Housing and Urban-Rural Development on holding a "Smart City Planning and Construction Management Training Course"	Departmental Working Paper	Housing and Urban-Rural Development	2015.11.26	2015.11.26
17	Notice of the National Standards Committee on the issuance and revision of 23 national standards including the "Smart City Evaluation Model and Basic Evaluation Index System Part 1: Overall Framework"	Departmental Working Paper	National Standardization Administration	2015.10.27	2015.10.27
18	Notice of the Department of Building Energy Efficiency and Technology of the Ministry of Housing and Urban-	Departmental Working Paper	Housing and Urban-Rural Development	2015.10.20	2015.10.20

	Title	Potency Level	Release Department	Release Date	Implementation
	Rural Development on the 2015 China-EU Smart City Summit				
19	Notice of the State Administration of Surveying, Mapping and Geographic Information on Promoting the Transformation and Upgrading of Digital Cities to Smart Cities	Departmental Working Paper	National Bureau of Surveying, Mapping and Geographic Information (former National Bureau of Surveying and Mapping) (cancelled)	2015.05.07	2015.05.07
20	Notice of the General Office of the Ministry of Housing and Urban-Rural Development and the General Office of the Ministry of Science and Technology on the Announcement of the 2014 National Smart City Pilot List	Departmental Working Paper	Ministry of Housing and Urban-Rural Development; Ministry of Science and Technology	2015.04.07	2015.04.07
21	Notice of the Department of Land Surveying and Mapping of the State Administration of Surveying, Mapping and Geographic Information on Holding a Work Conference on the Transformation and Upgrading of Digital Cities to Smart Cities	Departmental Working Paper	National Bureau of Surveying, Mapping and Geographic Information (former National Bureau of Surveying and Mapping) (cancelled)	2014.11.25	2014.11.25
22	Notice of the Department of Land Surveying and Mapping of the National Bureau of Surveying, Mapping and Geographic Information on Holding a Training Seminar on the Construction of a Smart City Spatio-temporal Information Cloud Platform (2014)	Departmental Working Paper	National Bureau of Surveying, Mapping and Geographic Information (former National Bureau of Surveying and Mapping) (cancelled)	2014.09.04	2014.09.04
23	Notice of eight departments including the National Development and Reform Commission, the Ministry of Industry and Information Technology, and the Ministry of Science and Technology Issuing the Guiding Opinions on Promoting the Healthy Development of Smart Cities	Departmental normative documents	National Development and Reform Commission (including the former National Development Planning Commission and the former State Planning Commission); Ministry of Industry and Information Technology; Ministry of Science and Technology	2014.08.27	2014.08.27
24	Notice of the General Office of the Ministry of Housing and Urban-Rural Development and the General Office of the Ministry of Science and Technology on Carrying out the 2014 National Smart City Pilot Application	Departmental Working Paper	Ministry of Housing and Urban-Rural Development; Ministry of Science and Technology	2014.08.22	2014.08.22
25	Reply of the China Securities Regulatory Commission on Approving the Raising of Huaifu Smart City's Flexible Allocation of Hybrid Securities Investment Funds	Administrative license approval	China Securities Regulatory Commission	2014.07.28	2014.07.28

	Title	Potency Level	Release Department	Release Date	Implementation
26	Notice from the Office of the National Bureau of Surveying, Mapping and Geographic Information on Participating in the Special Research Class on Digital City Construction and Smart City Exploration	Departmental normative documents	National Bureau of Surveying, Mapping and Geographic Information (former National Bureau of Surveying and Mapping) (cancelled)	2014.06.20	2014.06.20
27	Pre-notification of the National Land Surveying and Mapping Department of the National Bureau of Surveying, Mapping and Geoinformation on the holding of a work conference on the transformation and upgrading of digital cities to smart cities	Departmental Working Paper	National Bureau of Surveying, Mapping and Geographic Information (former National Bureau of Surveying and Mapping) (cancelled)	2014.06.20	2014.06.20
28	Notice of the Personnel Department of the National Bureau of Surveying, Mapping and Geographic Information on Implementing the Special Research Class on Digital City Construction and Smart City Exploration	Departmental normative documents	National Bureau of Surveying, Mapping and Geographic Information (former National Bureau of Surveying and Mapping) (cancelled)	2014.06.18	2014.06.18
29	Notice of the General Office of the Ministry of Housing and Urban-Rural Development on the Announcement of the 2013 National Smart City Pilot List	Departmental Working Paper	Housing and Urban-Rural Development	2013.08.01	2013.08.01
30	Notice of the Investment Promotion Bureau of the Ministry of Commerce on Organizing a Delegation to Participate in the "2013 Barcelona Smart City Expo"	Departmental Working Paper	Ministry of Commerce	2013.08.01	2013.08.01
31	Notice of the General Office of the Ministry of Housing and Urban-Rural Development on Carrying out the 2013 Pilot Application for the National Smart City	Departmental Working Paper	Housing and Urban-Rural Development	2013.05.03	2013.05.03
32	Notice of the Department of Land Surveying and Mapping of the State Administration of Surveying, Mapping and Geographic Information on holding a pilot training seminar on the construction of a smart city spatiotemporal information cloud platform	Departmental Working Paper	National Bureau of Surveying, Mapping and Geographic Information (former National Bureau of Surveying and Mapping) (cancelled)	2013.04.09	2013.04.09
33	Notice of the General Office of the Ministry of Housing and Urban-Rural Development on Doing a Good Job in the National Smart City Pilot Work	Departmental normative documents	Housing and Urban-Rural Development	2013.01.28	2013.01.28
34	Notice of the National Bureau of Surveying, Mapping and Geographic Information on Launching the Pilot Work of Building a Smart City Space-Time Information Cloud Platform	Departmental Working Paper	National Bureau of Surveying, Mapping and Geographic Information (former National Bureau of Surveying and Mapping) (cancelled)	2012.12.08	2012.12.08

	Title	Potency Level	Release Department	Release Date	Implementation
35	Notice of the General Office of the Ministry of Housing and Urban-Rural Development on Carrying out the National Smart City Pilot Work	Departmental Working Paper	Housing and Urban-Rural Development	2012.11.22	2012.11.22
36	Notice of the Office of Beijing Big Data Work Promotion Group on Printing and Distributing the "Guiding Opinions on the Construction of Beijing's New Smart City Perception System"	local normative documents	Office of Beijing Big Data Work Promotion Group	2021.03.22	2021.03.22
37	Notice of the Beijing Big Data Work Promotion Group on Printing and Distributing the "Beijing 14th Five-Year Plan Period for Smart City Development Action Outline"	local working papers	Office of Beijing Big Data Work Promotion Group	2021.03.05	2021.03.05
38	Notice of the People's Government of Daxing District, Beijing on Printing and Distributing the "Master Plan for New Smart City in Daxing District (Revised Edition)" (2021)	local working papers	People's Government of Daxing District, Beijing	2021.01.25	2021.01.25
39	Notice of the People's Government of Daxing District, Beijing on Printing and Distributing the Action Plan for Promoting the Construction of New Smart City in Daxing District (2018-2021) (Revised Edition)	local working papers	People's Government of Daxing District, Beijing	2021.01.25	2021.01.25
40	Notice of the Beijing Daxing District People's Government Office on Printing and Distributing the "Daxing District New Smart City Construction Leading Group and Office Composition Plan"	local working papers	People's Government of Daxing District, Beijing	2018.07.04	2018.07.04
41	Notice of the People's Government of Daxing District, Beijing on Printing and Distributing the "Master Plan for New Smart City in Daxing District"	local working papers	People's Government of Daxing District, Beijing	2018.05.15	2018.05.15
42	Notice of the People's Government of Daxing District, Beijing on Printing and Distributing the Action Plan for Promoting the Construction of New Smart City in Daxing District (2018-2020)	local working papers	People's Government of Daxing District, Beijing	2018.04.26	2018.04.26
43	Notice of the Shanghai Municipal Commission of Economic and Information Technology on Solicitation of Smart City Pilot Demonstration Projects	local working papers	Shanghai Municipal Commission of Economy and Information Technology	2020.05.13	2020.05.13
44	Notice of the Shanghai Changning District People's Government Office on the Establishment of the Leading Group for Smart City Construction in Changning District	local working papers	Shanghai Changning District People's Government	2020.02.27	2020.02.27
45	Notice of the General Office of the Shanghai Municipal People's Government on the Establishment of	local working papers	Shanghai Municipal People's Government	2019.07.20	2019.07.20

	Title	Potency Level	Release Department	Release Date	Implementation
	the Leading Group for Shanghai Smart City Construction				
46	Notice of the Shanghai Municipal Commission of Economy and Informatization on Launching the 2019 Shanghai Informatization Development Special Fund (Smart City Construction and Big Data Development) Project Application	local working papers	Shanghai Municipal Commission of Economy and Information Technology	2019.01.03	2019.01.03
47	Notice of the Shanghai Municipal Commission of Economy and Informatization on the Application for the 2017 Shanghai Informatization Development Special Fund (Smart City Construction) Project	local working papers	Shanghai Municipal Commission of Economy and Information Technology	2016.12.30	2016.12.30
48	Notice of the Shanghai Municipal People's Government on Printing and Distributing the "13 th Five-Year Plan for the Promotion of Smart City Construction in Shanghai"	local working papers	Shanghai Municipal People's Government	2016.09.19	2016.09.19
49	Notice of the People's Government of Yangpu District, Shanghai on Printing and Distributing the Three-Year Action Plan (2015-2017) for the Construction of "Smart City" in Yangpu District	local working papers	Shanghai Yangpu District People's Government	2016.07.18	2016.07.18
50	Notice of the Office of the People's Government of Baoshan District, Shanghai on the Establishment of the Leading Group for Smart City Construction in Baoshan District	local working papers	Shanghai Baoshan District People's Government	2016.05.17	2016.05.17
51	Notice of the Shanghai Municipal Commission of Economy and Informatization on the Application for the First Batch of Shanghai Informatization Development Special Funds (Smart City Construction) Projects in 2016	local working papers	Shanghai Municipal Commission of Economy and Information Technology	2016.03.08	2016.03.08
52	Notice of Shanghai Municipal Commission of Economic and Information Technology on Launching the Application for 2014 Shanghai Smart City Construction Projects	local working papers	Shanghai Municipal Commission of Economy and Information Technology	2014.09.12	2014.09.12
53	Notice of Shanghai Municipal Commission of Economy and Informatization on Holding the 3rd Shanghai Smart City Experience Week and the 4th Information Security Week	local working papers	Shanghai Municipal Commission of Economy and Information Technology	2014.09.12	2014.09.12
54	Notice of the Shanghai Municipal Commission of Economy and Information Technology on the announcement of the second batch of Shanghai Smart City Experience	local working papers	Shanghai Municipal Commission of Economy and Information Technology	2013.10.25	2013.10.25

	Title	Potency Level	Release Department	Release Date	Implementation
	Centers				
55	Notice of Shanghai Municipal Commission of Economy and Information Technology on Carrying out Smart City Citizen Experience Work	local working papers	Shanghai Municipal Commission of Economy and Information Technology	2012.08.10	2012.08.10
56	Notice of Shanghai Water Affairs Bureau on Printing and Distributing the Implementation Plan of Shanghai Water Affairs Bureau for Implementing the "Shanghai 2011-2013 Action Plan for Promoting Smart City Construction"	local working papers	Shanghai Water Affairs Bureau	2012.05.26	2012.05.26
57	Shanghai's 2011-2013 Action Plan for Promoting Smart City Construction	local working papers	Shanghai Municipal People's Government	2011	2011
58	Notice of Jinshan District People's Government on Printing and Distributing the "Three-Year Action Plan for Smart City Construction in Jinshan District (2018-2020)"	local working papers	Shanghai Jinshan District People's Government	2018.07.06	2018.07.06
59	Announcement of the Guangzhou Municipal Bureau of Industry and Information Technology on entrusting the Guangzhou Intelligent Connected Vehicle Demonstration Zone Operation Center to carry out the Guangzhou Intelligent Connected Vehicle and Smart City Collaborative Development Achievement Promotion Project	local working papers	Guangzhou Bureau of Industry and Information Technology	2021.04.01	2021.04.01
60	Notice of Guangzhou Municipal Bureau of Science and Technology and Information Technology on Holding the Engineering Science and Technology Forum on "Development Trend of Smart City and Digital Home Technology Industry"	local working papers	Guangzhou Science and Technology and Information Technology Bureau	2010.11.18	2010.11.18
61	Notice of the Guangdong Provincial Department of Science and Technology on Organizing the Application for the National Key R&D Program "Key Technologies and Demonstrations of the Internet of Things and Smart City" Key Special Projects in 2019	local working papers	Guangdong Provincial Department of Science and Technology	2019.10.22	2019.10.22
62	Notice of the General Office of the People's Government of Guangdong Province on Printing and Distributing the Action Plan (2014-2020) to Promote the Construction of Smart City Clusters in the Pearl River Delta and the Integration of Informatization	local working papers	People's Government of Guangdong Province	2014.11.07	2014.11.07

	Title	Potency Level	Release Department	Release Date	Implementation
63	Several Opinions of Shenzhen Municipal People's Government on Accelerating the Construction of Smart City and Digital Government	local normative documents	Shenzhen Municipal People's Government	2020.12.29	2020.12.29
64	Notice of Shenzhen Municipal People's Government on Establishing Shenzhen Smart City and Digital Government Construction Leading Group	local working papers	Shenzhen Municipal People's Government	2021	2021
65	Notice of the Shenzhen Municipal People's Government on Printing and Distributing the Overall Plan for the Construction of a New Smart City	local working papers	Shenzhen Municipal People's Government	2018.07.12	2018.07.12
66	Notice of Shenzhen Economic and Trade Information Commission on Invitation to Participate in the "Going out to serve China" and the "Belt and Road" Smart City Summit Forum	local working papers	Shenzhen Municipal Commission of Economy, Trade and Information Technology	2015.11.10	2015.11.10