Analysis of the Current Situation of Smart City Construction in China and Research on Improvement Countermeasures

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Abstract: *In the context of the deep integration of digital technology revolution and new urbanization strategy, the construction of smart cities has become an important path to solve the "urban disease" and achieve modernization of governance. This study adopts literature research and case analysis methods to systematically sort out the connotation, characteristics, and development evolution of smart cities. Through analysis, the current status of smart city construction in China is obtained, and the shortcomings in the current process of smart city construction in China are pointed out. In response to the shortcomings, this study proposes a "five in one" improvement strategy of policy innovation and capital synergy, reconstruction of new infrastructure system, technological breakthroughs and achievement transformation, circulation of data elements, and upgrading of security system. It provides practical reference for the transformation of Chinese path to modernization cities, and also provides experience for the construction of smart cities in developing countries.*

Keywords: *Smart City, Urban Governance, Current Situation Analysis, Countermeasure Research*

1.Introduction

In the macro context of accelerating global digital transformation, the construction of smart cities has become a strategic choice for reconstructing urban governance paradigms and reshaping regional competition patterns. Smart cities, as an emerging concept and model of urban development, have gradually gained widespread recognition and practice worldwide[1]. The concept of smart city was first proposed by IBM in 2008. Its core lies in integrating the core system of urban operation using information technology to achieve intelligent response in areas such as people's livelihood, environmental protection, and public safety. Subsequently, this concept quickly spread globally and became a strategic direction for digital transformation in cities around the world. The European Union, Singapore, Japan and other countries and regions have taken the lead in launching smart city construction, forming a number of exemplary cases[2]. As a developing country, China also attaches great importance to the construction of smart cities. Since the announcement of the first batch of national smart city pilot projects in 2013, China has launched over 700 pilot projects covering multiple dimensions such as urban governance, public services, and industrial development. The construction of smart cities in China began in 2008 and has achieved significant results after more than a decade of development. However, it still faces many challenges such as traffic congestion, environmental pollution, and resource shortages, which are known as "urban diseases". Thoroughly studying the current situation of China's smart city construction, analyzing its existing problems, and proposing practical and feasible improvement measures are of great significance for promoting the sustainable development of smart cities.

This article adopts methods such as literature research and case analysis to conduct an in-depth analysis of the current situation of smart city construction in China. By consulting relevant academic papers, research reports, policy documents, and other materials, understand the definition, development history, current situation, problems, and improvement strategies of smart cities.

2. Overview of Smart Cities

2.1 Definition and connotation of smart city

Smart city is an advanced form of contemporary urban evolution, whose essence lies in the deep integration of new generation information technology and urban development genes, and the construction of a new intelligent, digital, and ecological urban ecosystem. The core connotation of a smart city lies in the use of cutting-edge technologies such as the Internet of Things, cloud computing, big data, and artificial intelligence to globally optimize the urban operation system, achieve refined urban management, convenient public services, intelligent industrial development, and sustainable ecological environment[3].

From the perspective of the technological architecture of smart cities, they have four pillar characteristics: firstly, ubiquitous perception - by deploying intelligent sensor networks covering the entire city, multi-dimensional real-time perception of the city's operating status can be achieved. For example, environmental monitoring sensors can accurately capture air quality data, and intelligent transportation systems can dynamically identify traffic density; Secondly, interconnection and networking - relying on the high-speed ubiquitous 5G/F5G network infrastructure, we will build a deeply interconnected smart city neural network of "people, things and fields", so that the government cloud, urban data platform and Internet of Things terminals can form a seamless connection; Thirdly, computational intelligence - using machine learning and deep learning algorithms to deeply mine urban big data, building a self optimizing "city brain" to achieve intelligent decision-making such as dynamic traffic signal timing and energy demand forecasting; Fourthly, service collaboration - breaking the traditional segmentation of urban management and building a cross departmental business collaboration platform, such as the "one network unified management" system integrating data from municipal, emergency, environmental protection and other departments, to achieve closed-loop management of urban governance.

From the perspective of realizing the value of smart cities, they demonstrate three core advantages. Firstly, governance efficiency has risen - through data-driven decision-making paradigm transformation, urban managers can accurately grasp the laws of urban operation. Secondly, innovation in people's livelihood experience - Smart cities significantly improve residents' quality of life through scenario based service innovation. Third, industrial ecological reconstruction - smart cities promote the digital transformation of traditional industries and the cultivation of emerging industries through digital twins, industrial Internet and other technologies.

2.2 Development process of smart cities

The construction of smart cities in China began in 2008 and has gone through multiple stages of development:

(1) Initial stage (2008-2012)

The construction of smart cities began with IBM's "Smart Earth" vision proposed in 2008, whose core essence is to use new generation information technology to reconstruct the operational logic of cities. During this period, although no special policies were introduced at the national level, the "National Medium - and Long Term Science and Technology Development Plan Outline (2006-2020)" has proactively proposed the direction of "digital city" construction. At the local practical level, pioneering cities such as Wuxi and Shanghai have taken the lead in piloting the application of the Internet of Things. Wuxi established the country's first IoT research institute in 2009 to explore the integration of sensor networks and urban management. In terms of technology, RFID, 3G communication and other technologies have been preliminarily applied in fields such as intelligent transportation and environmental monitoring, laying the foundation for future development.

(2) Pilot phase (2013-2015)

In 2013, the country announced the first batch of 90 pilot projects for smart cities, marking the entry of smart city construction into a standardized development track. At the policy level, the Guiding Opinions on Promoting the Healthy Development of Smart Cities clearly propose the construction principles of "perceptible, interconnected, and operable", and establish a three-level collaborative promotion mechanism of "department province city". In terms of technological breakthroughs, cloud computing and big data technologies are gradually maturing, supporting the construction of city level data platforms. On a practical level, Ningbo has built a "one cloud, multiple applications" system, integrating more than 30 applications such as smart urban management and smart healthcare; Yangzhou is the first to achieve full coverage of 4G network, providing a high-speed channel for smart applications. At this stage, a closed-loop development system of "technology driven policy guidance application innovation" is formed.

(3) Promotion stage (2016 present)

In 2016, the "Evaluation Indicators for New Smart Cities" were released, promoting a shift in the focus of construction from "technology driven" to "value realization". In terms of policy, the 14th Five Year Plan for the Development of Digital Economy proposes the construction of "digital twin cities" and emphasizes the market-oriented allocation of data elements. In terms of technological innovation, artificial intelligence, digital twins, blockchain and other technologies are deeply applied. For example, Shenzhen has built a “City Information Model (CIM) Basic Platform” to achieve full domain 3D visualization control; Xiong'an New Area has used blockchain technology to build an engineering fund supervision platform to ensure transparent and efficient project construction. In terms of practical results, Hangzhou's "City Brain" processes more than 1.2PB of data per day, reducing the time for 120 emergency vehicles to arrive on site by 40%; Suzhou Industrial Park has built a “5G+AI” industrial ecosystem, gathering more than 800 intelligent manufacturing enterprises.

3. Analysis of the Current Status of Smart City Construction in China

3.1 Results achieved

3.1.1 Improving urban management efficiency

Smart cities reconstruct urban governance logic through new generation information technology, achieving a leap in management efficiency[4]. The Jiangxia District of Wuhan City has utilized satellite remote sensing technology to construct an integrated inspection system for "air, space, and earth". The discovery cycle for illegal buildings has been shortened by 60%, and the demolition efficiency has been improved by 45%; Suzhou has built a "city data brain" that integrates systems such as the 12319 urban management hotline and digital urban management, achieving an accuracy rate of 98.6% for work order distribution and reducing the average time for case handling to 2.3 hours. The "City Brain" in Hangzhou city processes an average of over 1.2PB of data per day, reducing the arrival time of 120 emergency vehicles by 40% and decreasing traffic congestion index by 15%. In terms of technology, digital twin technology supports real-time simulation decision-making. For example, Shenzhen's "Digital Twin City Space Service Platform" integrates more than 200 services from 10 categories to achieve dynamic deduction of planning schemes; Blockchain technology strengthens regulatory efficiency, and the Xiong'an New Area project fund supervision platform ensures transparent operation of projects.

3.1.2 Improving residents' quality of life

The construction of smart cities is guided by human needs and promotes universal access to public services. In the medical field, the Ningbo Cloud Hospital platform provides remote consultations, electronic prescriptions, and other services, covering over 80% of primary healthcare institutions; In the field of education, the "Three Classrooms" model benefits 280 million users and promotes the sharing of high-quality resources. In terms of living experience, Baiye Smart New City has built a distributed energy system to achieve full coverage of household energy management; The Shanghai "Smart Public Security" system uses facial recognition technology to increase the criminal case solving rate by 32%. In terms of caring for special groups, the "Smart Elderly Care" platform in Suzhou has implemented functions such as safety warnings for elderly people living alone and online processing of elderly subsidies; The "Smart Community" project in Wuxi integrates intelligent garbage classification, shared parking and other services to enhance the convenience of residents' lives.

3.1.3 Promoting Economic Development

Smart cities stimulate new economic vitality through the dual drive of digital industrialization and industrial digitization[5]. Zhengzhou High tech Zone is building a smart city experimental field, attracting leading enterprises such as Huawei and Alibaba to participate, incubating 30 application scenarios, and driving local enterprise revenue growth of over 1 billion yuan; Xuzhou City relies on the construction of smart cities to promote industrial upgrading, and the industrial ecology of intelligent manufacturing, smart logistics, and other industries has initially formed. In terms of technological innovation, technologies such as the Internet of Things and artificial intelligence are deeply applied in the construction of smart cities, such as Shenzhen's "5G+AI" industry scale exceeding 500 billion yuan;

The digital twin technology has given rise to new business models, and the "City Information Model (CIM) Platform" in Guangzhou has supported a 20% increase in output value in the field of engineering construction. In terms of sustainable development, energy-saving technologies such as smart street lights and intelligent buildings have reduced urban comprehensive energy consumption by 18% and carbon emissions by 15%.

The three major achievements form a virtuous cycle: improving management efficiency, optimizing resource allocation, and releasing space for innovation in serving people's livelihoods; The improvement of quality of life stimulates new consumer demand and promotes the evolution of industrial ecology; Economic development feeds back the upgrading of the governance system, forming a sustainable development model that integrates technology, governance, and humanities. Typical cases show that the construction of smart cities reduces urban governance costs by 25% -40%, increases public service satisfaction by more than 30%, and continues to lead traditional industries in digital economy growth, fully verifying its strategic value and practical significance.

3.2 Existing Problems

3.2.1 Lack of top-level design

There is a significant lack of top-level design in the current construction of smart cities, leading to vague strategic direction and chaotic execution paths. Due to a lack of clear target positioning, the smart city project in Wuhan failed to generate effective output with an investment of 175 million yuan, ultimately becoming a "stalled project". This exposes the serious phenomenon of blindly following the trend in some cities, turning the construction of smart cities into a political achievement project. The field of smart community elderly care also faces the dilemma of missing standards, with many regions promoting decentralized governance models, resulting in duplicate resource allocation and low management efficiency. At its root, it lies in the lack of a national level smart city standard system, which leads to fragmented planning in various regions and difficulty in unifying technical interfaces and data standards.

3.2.2 Data Island Effect

As the core asset of smart cities, data's circulation efficiency directly affects governance effectiveness. Due to the lack of top-level design, the information systems of various departments in Guiyang High tech Zone have formed more than 70 data islands, which not only increases operation and maintenance costs, but also leads to the failure of cross departmental collaboration. The dilemma of government data sharing is particularly prominent: barriers to approval authority, division of departmental interests, and differences in technical standards form a "triple shackle", and some institutions evade procedural information sharing through data cleaning, seriously weakening data integrity. This phenomenon of "data fragmentation" results in a lack of comprehensive decision-making support for smart governance3.2.2 Data Island Effect[6].

3.2.3 Security Threat Upgrade

The security vulnerability of smart city systems is becoming a major hazard. The SWARCO traffic signal controller vulnerability (CVE-2020-12493) allows hackers to remotely manipulate the signal system, which may cause traffic paralysis. More seriously, smart city devices commonly have basic security vulnerabilities, such as pre authentication vulnerabilities in Libelium IoT gateways and default credential risks in Echelon smart routers, which provide opportunities for hacker attacks. A security audit in a German city found that 80% of smart city devices have unrepaired vulnerabilities, and most of them are directly exposed to the public network. This indicates that security construction lags behind technological development and threatens the safety of urban operations [7].

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3.2.4 Imbalance of financial benefits

The construction of smart cities presents high investment and long-term characteristics, with significant financial pressure[8]. In the failed case of the Wuhan project, the efficiency of fund utilization was less than 30%, reflecting the drawbacks of the traditional "one-time investment" model. The deeper contradiction lies in the fact that repeated construction leads to resource waste, such as the repeated investment of over 40% in the electronic government system of the high-tech zone; The operation and maintenance costs lack sustainable guarantees, with some cities' annual operation and maintenance expenditures accounting for 60% -80% of construction investment. This short-sighted thinking of "emphasizing construction over operation" has led to the trap of "digital image engineering" in the construction of smart cities.

The above problems form a closed-loop constraint: the lack of top-level design exacerbates data silos and reduces financial efficiency; Poor data flow weakens security prevention and control capabilities, and amplifies risk exposure; Security threats have forced closed data management, further solidifying departmental barriers. The solution lies in building a “trinity” governance framework: led by a national standard system, establishing a mechanism for data ownership and profit distribution; Develop independently controllable security protection technologies and establish a full lifecycle security management system; Innovate the funding model of “government guidance+market operation” to achieve sustainable value circulation. Only in this way can we promote the transformation of smart cities from “construction” to “operation” and unleash the true dividends of technological revolution.

4. Improvement measures

4.1 Policy Innovation and Capital Synergy

Build a three in one policy innovation framework of "demand system efficiency" and strengthen the strategic guidance role of top-level design. A dynamic policy response mechanism needs to be established to drive technological adaptation through a demand graph, and to resolve the structural contradiction between technological iteration and governance needs through institutional flexibility. At the level of capital operation, explore a diversified investment system, integrate fiscal funds, social capital, and financial innovation tools, and form a parallel capital allocation model of infrastructure asset securitization, industrial fund guidance, and data element marketization. At the same time, improve the risk sharing mechanism, optimize resource allocation efficiency through a full lifecycle assessment model, and ensure a dynamic balance between capital investment and value output.

4.2 Reconstruction of New Infrastructure System

Promote the architecture upgrade of network infrastructure, achieve the integration of 5G private network slicing, IoT edge cloud collaboration, IPv6 ubiquitous access and other technologies, and build an intelligent and elastic network foundation. Optimize the spatial layout and energy efficiency management of data centers, adopt green technologies such as liquid cooling and waste heat recovery to reduce energy intensity, and form a regional collaborative computing resource allocation system. Strengthen the basic support capabilities of the digital twin platform, and achieve precise mapping and interactive feedback between urban physical space and digital space through multi-source heterogeneous data fusion and spatiotemporal modeling technology.

4.3 Technical breakthroughs and achievement transformation

Focusing on key technological bottlenecks such as small sample learning of artificial intelligence, cross chain interoperability of blockchain, and virtual real mapping of digital twins, we aim to build a collaborative innovation alliance between industry, academia, and research. Improve the technology transformation chain, establish a progressive R&D system from basic research to scenario verification, and connect laboratory achievements with application scenario requirements through pilot bases. Strengthen intellectual property protection and standard system construction, form a technology ecosystem with independent and controllable characteristics, and enhance the market penetration rate and industrial adaptability of core technologies.

4.4 Flow of Data Elements

Establish a comprehensive governance framework covering data ownership, sharing, and transactions throughout the entire process. Develop open standards for graded and classified data, innovate privacy protection technologies such as data sandboxes and federated computing, and solve the paradox of data silos and security. Promote the construction of a data asset registration and value evaluation system, and establish a market-oriented circulation mechanism. By balancing data openness and security control through institutional innovation, a "usable but invisible" data element circulation paradigm is formed, releasing the multiplier effect of data resources.

4.5 Security System Upgrade

Develop lightweight encryption algorithms, adversarial defense models, and other active security technologies to enhance the anti attack capabilities of IoT terminals and intelligent algorithms. Build a dynamic protection system that integrates monitoring, response, and recovery to achieve real-time perception and rapid disposal of network security threats. Improve security management standards and compliance frameworks, establish a risk assessment mechanism covering the entire planning, construction, and operation cycle, and achieve the organic unity of privacy protection and collaborative governance through multi-party security computing and other technologies.

5. Conclusion

The construction of smart cities in China has achieved significant results, but still faces many challenges. By strengthening innovation support, consolidating infrastructure construction, promoting technological upgrading and achievement implementation, enhancing data sharing and openness, and strengthening information security, the sustainable development of smart cities can be promoted. In the future, the construction of smart cities in China will continue to develop towards greater intelligence, efficiency, and humanization, bringing more benefits to urban governance and residents' lives.

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