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INTRODUCTION

Reasons for choosing a topic for a Master's thesis. Modern cities and communities are constantly facing demographic change, ageing and deteriorating infrastructure, and increasing demands on municipal systems and services. There is a growing need to make more efficient use of limited urban space, increase resilience to climate change and natural and man-made disasters, raise public awareness and introduce new ways of supporting residents across all socio-economic levels. Each city, community or region is a unique entity, so smart city and community development strategies aim at the integrated and environmentally adapted implementation of information and communication technologies to improve living conditions and the quality of municipal services.

The separate operation of each basic municipal system is inefficient. Operational efficiency is significantly improved when all municipal systems are integrated into the overall information technology and socio-communication complex of a smart city. All smart city systems should be instrumented, interconnected and intelligent, with the ability to integrate as a system of systems, as the number of data sources in the urban environment is constantly growing - sensors, Internet of Things (IoT), social sources, web and mobile applications, commercial transactions, video surveillance devices, etc. Large, unstructured data sets (Big Data) from heterogeneous sources are produced by smart city applications. Because of the exponential growth in data volumes, processing speeds that are limited, and the high cost of scaling storage arrays, these data sets cannot be efficiently managed by the relational database technologies that are currently in use. To solve this class of problems, it is necessary to use BigData information technologies based on distributed data management and parallel processing that can provide the necessary data storage, distributed processing and interactive data visualisation.

The use of BigData information technology for smart city projects allows data to be stored and processed to provide analytical and statistical information to improve smart city services and information. The information tuples identified based on BigData processing will help local governments in decision-making processes when planning resources and smart city services. For large and poorly structured data in smart cities, it is necessary to develop tools and methods for fast and efficient storage, processing and analysis in order to identify hidden relationships and turn them into knowledge.

Degree of scientific development. The prospects of the Smart City concept as an effective response to the challenges of urbanisation are driving a significant and growing scientific and practical interest in the development of Smart Cities and their analysis, as reflected in the growing number of scientific publications on the subject, including special studies by international organisations, and the dynamic development of the market for technological solutions and systems for Smart Cities.

For example, while in 2000 there were 43 papers with the keyword "smart city" in the publications indexed in the Scopus database [64], in 2023 the number of papers was 7707. At the current stage of development of the theory of smart cities, research in this area is actively conducted by such foreign and Ukrainian scientists as Alba E., Al-Turjman F., Bibri S., Ghizani M., Yigitcanlar T., Kaleniuk I., Kuznetsova N., Kumar N., Mehmood R., Nesmakhnov S., Nesi P., Rodriguez J., Uninets I., Foschini L., Tsymbal L., etc. Issues and ways to ensure the development of smart cities are constantly on the agenda, being discussed and analysed by a number of international institutions, including the United Nations [69-76, 73], the World Intellectual Property Organization [75], the World Bank [82], the World Economic Forum [74], PWC [56], Deloitte [16], the International Organization for Standardization [13], etc. The global market for technological solutions and systems for smart cities is developing dynamically and is estimated at USD 549.1 billion in 2023, rising to USD 1114.4 billion in 2028 [69; 67].

Chinese scientists have made a significant scientific contribution. The following scientists have made significant scientific contributions: Xi

Guangliang [89], Zhang Yongming [85], Zhen Feng [88], Dang Anrong [92], Liu Yungang[94], Liu Shuyan [95].

Purpose of the Master's thesis. To reveal the essence of smart city financing, identify trends in its development in the world and the state of implementation in Chinese realities.

Objectives of the study:

- To identify the theoretical approaches to smart city funding
- To conduct an analysis of the financing of smart city development in China
- To identify ways to improve smart city funding.

The research focuses on the local financial system as a common space for the implementation of investment projects and smart city programmes.

The subject of the study is the financing of smart city development.

The theoretical value of the scientific discussion on smart city development in Chinese scientific thinking**.**

The practical significance lies in a thorough analysis of smart city finance and its budget forecast.

The elements of scientific novelty are as follows

- Development of the methodology of comparative analysis of smart cities of the International Institute for Management Development and the approach of the consulting company A.T. Kearney.

- Determination of the financial potential of the development of smart cities using Beijing as an example.

Testing of the research results. The main results and conclusions of the study were reported and discussed at the conference THEORETICAL AND PRACTICAL SCIENTIFIC ACHIEVEMENTS: RESEARCH AND RESULTS OF THEIR IMPLEMENTATION Pisa, Italy 13th of September 2024

Structure of the Master's thesis. The Master's thesis consists of 3 chapters, introduction, general conclusion, bibliography, necessary appendices, including notes in a foreign (Ukrainian) language. The total volume of the thesis is 154 pages

of computer text, including the main body of the thesis of 135 pages. The thesis contains 11 tables, 15 figures, 2 appendices on 2 pages. The list of references contains 149 sources.

CHAPTER 1.

THEORETICAL APPROACHES TO SMART CITY FINANCING

1.1. Historical and technological background of smart cities.

Historical and technological background of smart cities Over the past 20 years, humanity has witnessed significant progress driven by the emergence of computer technology and its capabilities. This is due to the development and improvement of measuring and computing machines used in information technology (IT) in the modern world.

As a result, we are witnessing a wider use of IT and its combination with the Internet of Things (IoT) in everyday life [1]. With the rapid development of science and technology, the Internet industry is in a state of continuous reform, where Internet technologies and urban construction have opened up new opportunities for the further construction of smart cities [2]. Developments in the field of IT make a significant contribution to the development of cities and the improvement of people's lives, which is explained by the multifunctionality, efficiency and convenience of IT solutions to solve the problems that cities may face [2, 26]. Smart cities in combination with IT and IP have a significant impact on the development of cities with an improved quality of life for the population.

These innovative technologies offer increased efficiency, convenience and safety for the urban environment. For example, IR can be widely used in the energy sector [2, 22], healthcare [29], ecology and solving environmental problems of the urban environment [48], automated resource management systems [47], which together combine smart technologies to improve the quality of life [26]. Therefore, one of the benefits of using smart technologies for smart cities is the improvement of infrastructure and public services associated with the use of sensors and connection to IP networks to obtain indicators of air pollution, electricity and water consumption, as well as providing traffic monitoring systems and other important

systems that may be directly related to the urban environment. Such indicators allow large settlements to plan development, use resources rationally, and improve the comfort and quality of life of the population [2; 26]. Public transport and traffic monitoring systems are relatively new technologies for ensuring safety through continuous monitoring using digital technologies (video cameras and warning systems) [62].

Surveillance systems are designed to provide video surveillance of roads and public spaces, helping to reduce the risk of unpleasant incidents and accidents by providing a rapid response. For example, the use of surveillance systems detects traffic jams in real time and automatically controls traffic lights, which helps to effectively improve urban traffic and reduce road congestion [45].

Smart cities stimulate innovation and the development of urban IT industries and play an important role in attracting IT companies and young professionals, which in turn contributes to the economic growth of cities. As a result, cities become more competitive in the global economic environment and attract investment [84]. Therefore, smart cities and IP have a significant impact on urban development, improving the quality of life of citizens, increasing efficiency and security, improving infrastructure and public services, and stimulating innovation and economic growth. The diffusion of these technologies in cities is undoubtedly the key to creating a more sustainable, technologically advanced and comfortable urban environment.

The current state of IT development and the implementation of IP in a single Smart City system includes many factors that can lead to breaches in the early stages of development. For example, when designing an Internet application, it is necessary to take into account the design, user interface, Internet connection and security protocols, where failure to comply with any of these can lead to system failure and leakage of confidential information. Other issues may be related to the power supply of IP devices (sensors) as they have a short period of continuous operation.

It is estimated that by 2050, around 65% of the world's population will live in large cities, resulting in a significant increase in population that will require the

implementation of sustainable development trends in large cities with effective local governance. However, current local development and governance practices are not able to mitigate some of the threatening effects of unsustainable urbanisation, making it impossible to improve the quality of life of the population. Therefore, in order to ensure and improve the quality of life, IT with a combination of IR, which combines a common management system to create smart technologies and smart cities, is considered [59].

The paper [13] describes simple smart city datasets based on the Internet of Things (automotive network, smart parking, smart home, environmental pollution, weather monitoring), which are considered as an analysis for creating a smart city with an urban planning solution.

The authors proposed an architecture consisting of four layers, namely: collection, aggregation, communication, processing and interpretation functions using Hadoop and Spark technologies, which allows information to be processed in real time. The proposed architecture and system allow for effective results when working with a large data set, which is explained by the throughput of the system, which increases with the size of the data. However, in order to implement the proposed architecture, it is necessary to pay attention to the security of the information transmission and to analyse all possible options for its leakage, which threatens the existence and use of such a proposed system.

The smart city market is expected to exceed $1.8 trillion in the next 20-25 years, but the interconnection of virtual and physical infrastructure ensures the operation of a smart city, creating new cybersecurity risks. Paper [13] provides recommendations for privacy and security in smart cities. The authors emphasise that with each additional access point, the vulnerability of sensitive information increases, and smart cities can be vulnerable to numerous cyber-attack methods, such as remote use and jamming of signals, downloading of malware, manipulation of information, etc.

The paper [13] states that the use of modern smart technologies in combination with IT increases security, reduces traffic, reduces environmental pollution and improves the overall quality of life of the population.

Some studies suggest that blockchain technologies can be used in a smart city for sustainable development and city management. In [80], the authors analysed the possibility of how cities can improve in many areas such as mobility, utilities, governance, resources and logistics using blockchain technology. The authors proposed a framework for the integration of smart cities and blockchain by conducting a survey among a large number of people to determine citizens' perceptions of the proposed framework for smart and sustainable urban development. At the same time, in [81], based on a critical analysis, the author explored how the insufficiently studied relationship between smartness and sustainability in the context of urban development may have discrepancies, which is likely to lead to parallel sustainability regimes due to the mismatch between smart technologies and societal needs. Therefore, in order to develop a comprehensive understanding of the relationship between smart technologies and urban life, the article [86] considers and analyses smart technologies in a broad sense, where examples of the use of such technologies include smartphone applications and storage devices (smartwatches, autonomous vehicles, intelligent transport systems, UAVs, robots and smart homes) generated by smart technologies.

There are many opportunities in IT-enabled urban development, but there are also new challenges that need to be addressed. The most common issues include inadequate infrastructure, lack of access to technology, cybersecurity and privacy issues, and technological innovations that threaten the preservation of cities' historical and cultural heritage. There is also a need to balance the introduction of such technologies to avoid a digital divide where some users have access to innovation and others do not.

It is therefore necessary to address these challenges at the level of policy, infrastructure and access to training. The development of smart cities using IP is also accompanied by new challenges, which are determined by the following factors:

1) Cybersecurity (the growing number of connected devices increases the likelihood of cyber-attacks), which requires protection against unauthorised access and hacking, as the vulnerability of one device can compromise all other devices in the existing system;

2) Data confidentiality (the collection of a huge amount of information from connected devices can violate the personal privacy of users), which can be ensured by efficient storage and processing of information based on the use of privacy standards;

3) Standardisation (the lack of uniform standardisation can lead to discrepancies between devices and systems, which is likely to complicate their interaction and integration);

4) Power management (many IP devices have limited power and battery life), the task of which is to ensure effective power management so as not to limit the functionality and performance of the system;

5) Resource management (the expansion of smart cities and the use of IP requires powerful computing resources and infrastructure);

6) Cost (the implementation of smart cities and IP systems can be an expensive task due to the installation and arrangement of new equipment and infrastructure);

7) Human factor (the success of such projects directly depends on the acceptance and involvement of the population in the use of new and innovative technologies, and inappropriate or inadequate training can be an obstacle).

The objective of this part of the Master's thesis is to study and analyse the use of smart technologies for a smart city based on the combination of information technologies and IoT devices, as well as to identify key criteria for the development of modern cities with an impact on improving the quality of life of the population. In accordance with the objective, the following tasks have been formed: to consider the main possibilities of using information technology in combination with electronic measuring and computing devices of the Internet of Things; to determine the characteristics of building information technology models with the connection of Internet of Things devices to switching networks; to analyse the architecture of

fog and edge computing for Internet of Things devices; to find out the main risks and problems of cybersecurity with the encryption of information of Internet of Things devices using specialised software; to identify the main risks and problems of cybersecurity with the encryption of information of Internet of Things devices using specialised software; to identify the main risks and problems of cybersecurity with the encryption of information of Internet of Things devices using specialised software.

An urgent problem is to identify and study the main possibilities of using smart technologies, in order to identify problems related to the feasibility of meeting the needs of the population. This paper considers and investigates the impact of a combined system with a set of smart technologies on improving the quality of life using eight branched systems, namely: smart infrastructure, smart economy, smart environment, smart governance, smart transport, smart services, smart people and smart life. The set of criteria of each system must be analysed and matched to the needs of the population so that the combined smart city system can provide the population with conditions that can improve the quality of life.

The hardware element of an IP device consists of a sensor (powered by a battery), an actuator and a communication system. The function of the sensor is to collect data from a specific environment. Such indicators can be flow rate, temperature, pressure, physical motion, distance, mass, etc.

The collected information is processed on the device, after which it can be sent to remote servers via a communication network to remote servers via a communication network [87]. Figure 1.1 shows the structure of the interaction between IPs using switching networks for different applications.

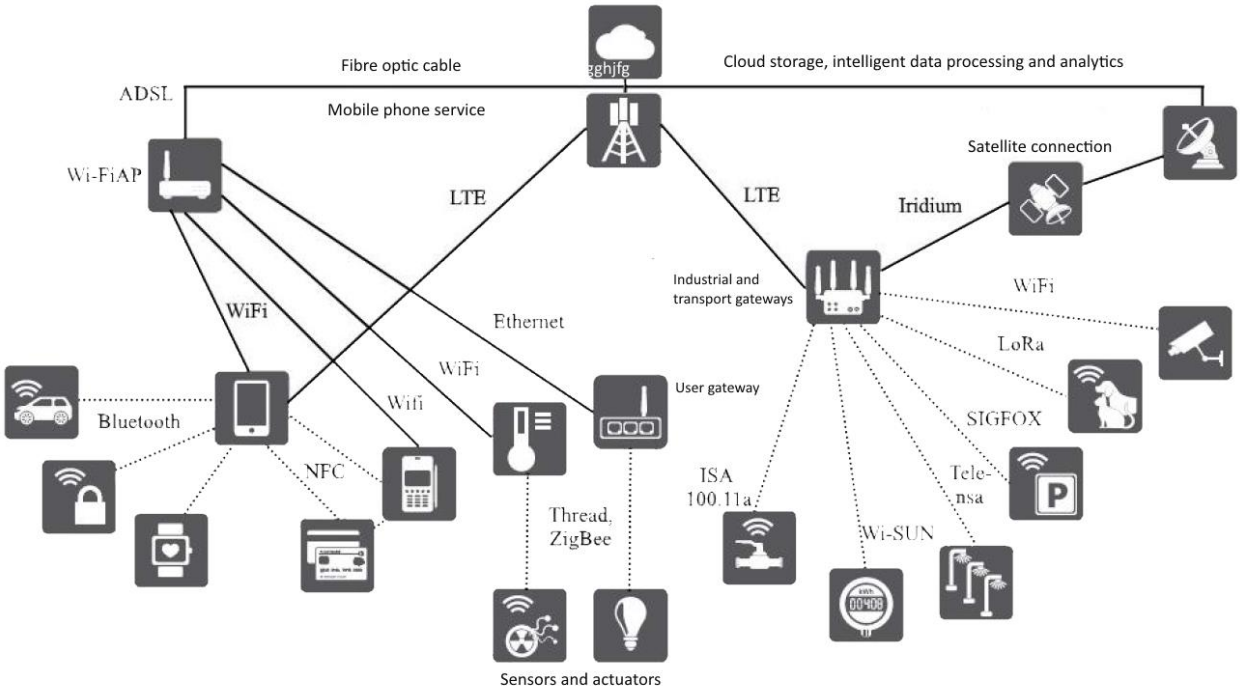

Figure 1.1 – The potential for utilising information technology (IT) in conjunction with internet protocol (IP) devices and switching networks for the processing of information.

Source: Author's compilation based on [87].

Sensors are IP devices that collect and process information for transmission to other devices. They use a lot of energy. The main problem with IP technology is that devices have a short battery life. A lot of power is used to collect and process information. The amount and accuracy of information depends on the battery life, which must be recharged regularly. This is a problem for the use of billions of interconnected devices.

A smart city is an urban environment where information technology and data are used to improve how it works, the quality of life of its residents and its sustainability. A smart city has the following features:

- Modern infrastructure, such as roads, buildings, energy systems and water supply;

- Transport, including electric cars, public transport and traffic management;

- Energy, including saving energy, distribution, renewable energy and monitoring;

- Water and waste management, including water systems, water saving and waste management;

- Connectivity, including high-speed internet, wireless networks and access to information for citizens;

- Information management - collecting, analysing and using information to improve city management;

- Social inclusion - providing access to technology for all communities and developing social initiatives;

- Security - using video surveillance, intelligent security and monitoring systems;

- Urban management - using data analysis to make decisions on urban development planning, resource management, crisis response, etc.

Information technology has transformed the development of cities and improved the quality of life by combining the urban system with intelligent technologies. Let's look at some of these systems in Table 1. It shows the main urban systems, sources (source executive bodies) and justification with indicators, which is a separate component of the urban system. Urban infrastructure refers to the built environment, including transport infrastructure (roads, bridges, tunnels, car parks, pedestrian areas); water infrastructure (water, wastewater and sanitation facilities used for water supply, wastewater and stormwater management); energy infrastructure used for electricity, gas and district heating as well as public lighting; infrastructure for urban waste collection and recycling; public buildings that

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Urban infrastructure is the built environment. It includes firstly, transport infrastructure (roads, bridges, tunnels, car parks, pedestrian areas); secondly, water infrastructure (water supply, wastewater and sanitation infrastructure used for water supply, wastewater and stormwater management); thirdly, energy infrastructure used for electricity, gas, district heating and public lighting; fourthly, municipal waste collection and recycling infrastructure; fifthly, public buildings used for sport, arts, culture, education, health and administration.

Table 1.1.

Smart city key indicators.

Urban system	Source	Indicators
Urban infrastructure	Municipal and intersectoral administration, providers of municipal services, managers of facilities managers	Digital model with geo-referencing for architecture and components (geographic information system, information modelling of buildings), performance indicators (traffic, congestion, consumption, flow, pressure, quality, voltage, frequency, temperature and humidity, accessibility)
Urban Environment	The city administration, environmental and meteorological services (NGO), municipal service providers, citizens, government agencies	Indicators for air pollution, water quality and soil quality, biodiversity, including green areas, biological species, public health indicators and safety indicators
City Services	City administration, as well as city service providers (transport, water, energy, municipal waste), citizens, companies	Indicators on the quality, availability, accessibility, and risks of urban services (mobility, energy and water supply, telecommunications, municipal waste, sanitation, healthcare, education, cultural, sports, and and artistic activities)

Urban system	Source	Indicators
Stakeholders of the City	Citizens and politicians, urban service providers and socio-economic actors	Indicators for citizens on city indicators (city services, strategies, significant projects, impact analysis, finances). Information from citizens, including feedback and assessment of city services, city functioning, quality of life, and suggestions for improvement
Social and Economic Activities	City administration, public authorities state authorities, public authorities, managers and providers of social activities, economic entities	Indicators on the type and distribution of socio-economic activities, potential of buildings, industrial and innovation potential, and the attractiveness of the city, availability and use of cultural and sports and sports facilities, availability of commercial and industrial land plots and industrial land plots, availability of labour force

Source: Author's compilation based on [66].

The indicators should include a digital model of the urban infrastructure using digital tools such as GIS (Geographic Information System) and BIS (Building Information System); dynamic indicators related to the functioning of the infrastructure, including fluid consumption, flow, pressure, fluid quality, electric voltage, current frequency, temperature and humidity.

Given the information in Table 1.1., it is possible to characterise an aggregate system that combines IT and IP, which together form an overall system of smart technologies. Unlike traditional city management, smart city technology has broader capabilities for smart infrastructure, economy, management and service delivery. Therefore, a smart city combines separate smart technology systems that are responsible for managing smart systems to prevent and solve problems and provide

users with the ability to create a smart society. For this purpose, a model has been built that combines the systems with their components into a single whole and includes interdependencies with each other, as shown in Figure 1.2.

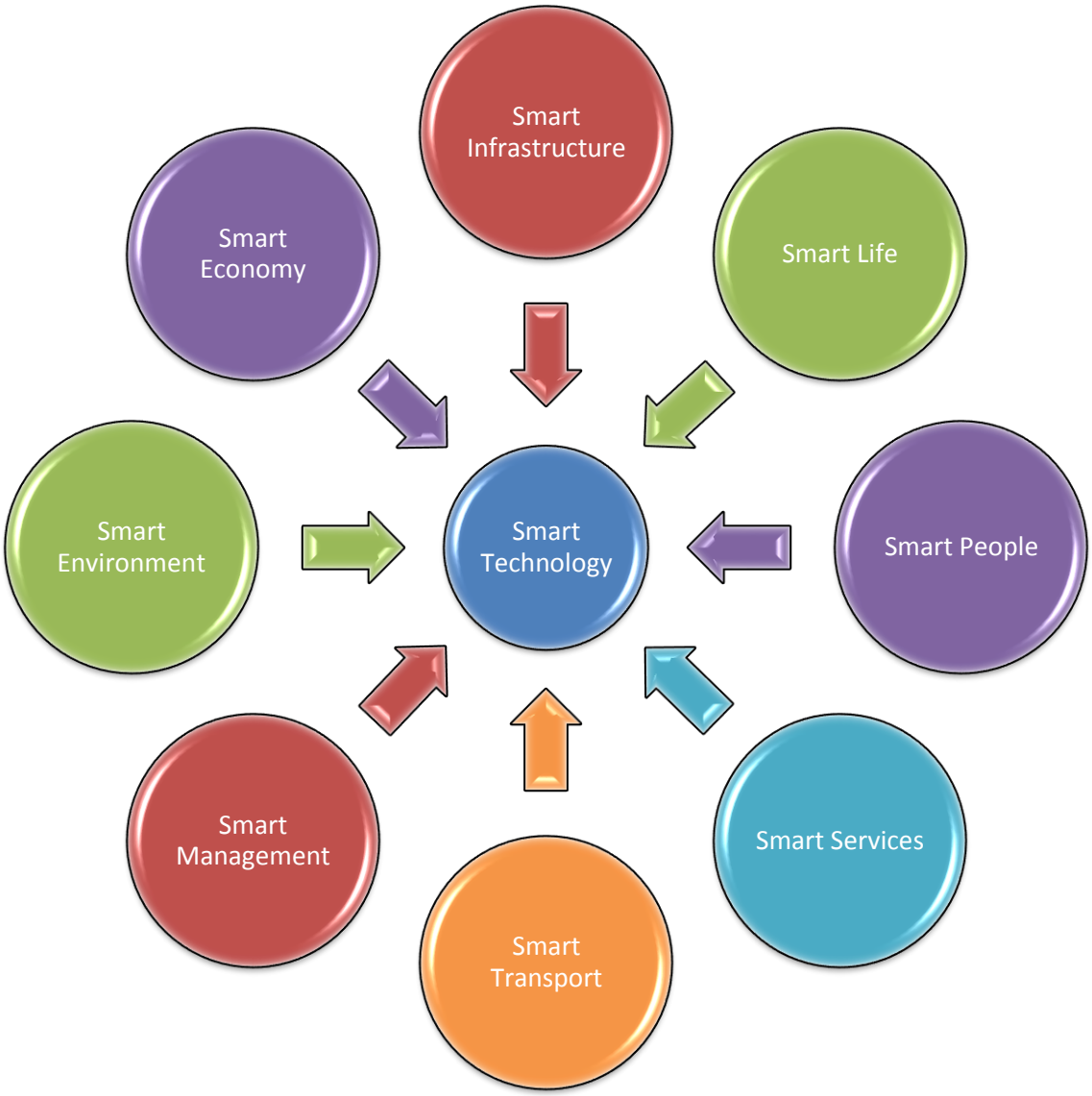

Figure 1.2 – Application of smart technologies in the field of information technology and their capabilities

Source: Author's compilation

Smart infrastructure is modern infrastructure equipped with information technologies and sensors that enable the collection, analysis and use of information

to optimise, operate and improve the quality of services to citizens. Table 1.2. shows the main characteristics of smart infrastructure.

Table 1.2.

Key features of smart infrastructure

Characteristic	Description
Connectivity	Smart infrastructure is based on connecting various elements - from roads and buildings to energy systems and water supply to the IP network - to collect and share information to optimise management
Sensors and detectors	Smart infrastructure contains a variety of sensors and detectors that collect data on the state of various infrastructure elements. This can include information on traffic, air quality, water quality, water level in reservoirs, etc.
Analysis of indicators	The collected indicators are analysed using various algorithms and artificial intelligence to identify patterns, trends and possible problems. This allows you to make informed decisions
Optimisation and management	Smart infrastructure helps to optimise resource use, reduce energy consumption, improve transport, ensure efficient water supply and wastewater disposal, etc.
Improving the quality of life	Smart infrastructure contributes to the growth of convenience for citizens. For example, it can provide information on transport, help to respond more quickly to to emergency situations, improve the quality of water supply, etc.
Sustainability	Smart infrastructure can contribute to resource and energy conservation more sustainably
Promoting innovation	Smart infrastructure creates new opportunities for the development of technologies and innovative approaches in various industries
Security and data protection	An important aspect of smart infrastructure is protecting information and ensuring cybersecurity, as a significant number of connected systems can become the object of cyber attacks

Source: Author's compilation

The smart economy is a concept based on the use of information technology, indicators and innovation for sustainable growth, improved quality of life and optimal use of resources. The main idea of the smart economy is to implement technological solutions that contribute to a more efficient functioning of the economy for the benefit of the country. Table 1.3 . shows the main characteristics of a smart economy.

Table 1.3.

Smart economy key features

Characteristic	Description
Digital transformation	The introduction of digital technologies, artificial intelligence, information analysis and automation helps to optimise business processes, increase productivity and ensure more accurate decision-making
Innovation	Fostering the development of new ideas, technologies and products is a key aspect of the of a smart economy. Investing in research and development, supporting start-ups, and cooperation between academia and business stimulate innovation development
Sustainability and resource efficiency	The smart economy is aimed at reducing the consumption of resources, energy and waste. The use of green technologies and practices helps to protect the environment and improve the sustainability and efficiency of resources
Flexibility and adaptability	A smart economy can quickly adapt to changes in society and market conditions and market conditions. Flexible management and the ability to respond to changes require the lowest possible costs
Open access to information	Information is a valuable asset in a smart economy. Ensuring access to and processing of information helps to identify trends, predict risks and develop new opportunities
Social integration	A smart economy must take into account the needs of different segments of society, providing access to technology and opportunities for all
Creating new markets	The smart economy fosters the emergence of new sectors and markets, based on innovation and technology

Source: Author's compilation

However, the introduction of the smart economy also brings new challenges, such as data protection, regulation of new technologies and the adaptation of the workforce to new requirements.

Smart people are users with experience in using smart technologies, as well as IT and IP professionals who use technology to solve various problems that have not yet been addressed. Many engineers, software developers, researchers and analysts design new technologies (create hardware and software solutions that allow different devices and sensors to connect to the IP network); analyse information (process large amounts of data collected from connected devices to identify trends and relationships); develop business solutions to help companies and customers; and work in analytics and artificial intelligence, using artificial intelligence techniques to improve the functions of the Internet of Things.

IP and automatic control and fault prediction, etc.; designing new applications to improve various aspects of life, from agriculture to medicine; researching new technologies and innovations to develop IP and ensure its effectiveness. In addition, specialists also study security and implement new methods and measures to ensure cybersecurity in the IP network to prevent hacking and unauthorised access.

Smart living is a concept that involves the use of information technology and innovation to improve the quality of life of citizens, ensure convenience, safety and sustainable development. This concept involves the introduction of various solutions and technologies that help make everyday life more comfortable and efficient. The main aspects include: 1. convenience (payments, purchases, reservations); 2. improved comfort (use of automated systems to control the home environment, lighting, temperature, etc.); 3. health and well-being (use of sensors and devices to monitor health, physical activity and ensure a healthy lifestyle); 4. security (use of video surveillance systems, alarms and other personal security technologies); 5. efficient use of resources (reduction of energy, water, materials, etc.).

Smart cities and communities provide citizens with access to innovation, modern services and opportunities for education, entertainment and development, and support environmental sustainability (using technology to support sustainable

development and minimise negative environmental impacts). Smart cities actively build a system of interaction with the community (introducing digital platforms for communication, involving citizens in decision-making and solving important problems).

Smart services use IT, analytics and innovation to improve the quality and efficiency of service delivery to citizens, businesses and other consumers, based on the use of information to provide individually tailored optimal solutions. Key aspects include: personalisation; interaction and communication (using digital platforms to ensure effective interaction between service providers and consumers); speed and convenience (smart services simplify processes and make them more accessible and convenient for users); quality improvement (using information to continuously improve the quality of service delivery); consumption on demand (smart services are delivered on demand and at the user's request); improving efficiency (using technology to optimise processes and reduce costs); forecasting (using analytical tools to anticipate needs and develop demand for services).

Smart management involves the use of IT to analyse information to optimise management processes, make informed decisions and improve the efficiency of various sectors, including business, government, organisations, etc.

It helps to reduce costs, improve service quality and ensure sustainability. The main characteristics of intelligent management are shown in Table 1.4.

Table 1.4.

Smart Management Key Features

Characteristic	Description
Collecting and analysing information	The use of sensors, transducers and other equipment to collect information about processes, quality, interactions, etc. Analysing this information helps to gain insights (perception of something not obvious) for decision-making
Artificial intelligence and analytics	Using machine learning and artificial intelligence algorithms to identify patterns, predict trends and solve complex problems

Characteristic	Description
Automation	Implementation of automated processes and robotics to improve efficiency and reduce the risk of errors
Interaction with citizens	Use of digital communication channels to ensure effective communication and engagement with citizens communication and involvement of citizens in decision-making
Resource optimisation	The use of information to optimise the use of resources, including energy, water, materials, etc.
Forecasting	Using analytical tools to predict events, changes and developments in situations
Monitoring and control	Monitoring and control systems that allow you to monitor various parameters and intervene in processes as needed
Improving services	The use of technology to improve the quality of service delivery, provided by organisations and institutions

Source: Author's compilation

Smart Transport is the concept of using IT and information to optimise traffic flow, ensure safety, improve service quality and reduce environmental impact. The goal of smart transport is to make urban transport more efficient, convenient and sustainable.

The main features of intelligent transport are 1. tracking (use of GPS and sensors to track the location of vehicles in real time); 2. traffic and navigation (use of information on traffic and road conditions to determine optimal routes and avoid congestion); 3. electric mobility (development of the popularisation of electric cars, provision of infrastructure for charging them); 4. shared transport (development of shared transport services that help to reduce the number of private cars on the roads); 5. unmanned control (development of autonomous cars and automatic control systems that can reduce the number of accidents and improve traffic efficiency); 6. Safety (use of video surveillance, emergency alarm systems and vehicle interaction to improve safety); 7. Effective management of public transport (use of information and technology to improve public transport timetables, movement and service); 8. Reduction of pollution (intelligent transport involves the development of ecological

vehicles and measures to reduce emissions of polluting substances); 9. Parking management (use of sensors and information to optimise parking and reduce the search for parking spaces).

Therefore, intelligent transport aims to improve traffic and mobility, reduce negative impacts on the environment and increase safety and comfort for citizens. It is an important aspect of sustainable urban development and the modern transport environment.

A smart environment is the concept of using IT and innovation to create effective and sustainable interactions between people, technology and the natural environment. The aim is to create a greener, healthier and more sustainable community where technology contributes to improving the quality of the environment.

We list the main aspects of an intelligent environment.

1. Monitoring of natural resources. The use of sensors to collect information on the quality of air, water, soil and other natural resources, helping to monitor pollution and contribute to better management of the environment.

2. Ecological design. Applying technologies and innovations in architecture, construction and design to create environmentally friendly and energy efficient buildings.

3. Energy efficiency. Implementing intelligent energy management systems, using renewable energy sources and reducing energy costs.

4. Intelligent waste management. Applying technologies to optimise the sorting, recycling and disposal of waste.

5. Green transport. Popularisation of electric, hybrid and other environmentally friendly means of transport.

6. Pollution control systems. Use of monitoring systems and information technologies to detect pollution and respond rapidly to environmental crises.

7. Citizen participation. Use of digital tools to raise environmental awareness and involve citizens in actions to improve the environment.

8. Agriculture and product cultivation. Using smart farming technologies to optimise cultivation and improve yields.

Taking into account the key aspects of an intelligent environment, it can be concluded that this technology ensures the conservation of natural resources, reduces the negative impact on the environment and improves the quality of life. Therefore, such a system is able to combine innovation with environmental responsibility to create a more sustainable and healthier future.

After analysing the common system of smart technologies, assume that each individual system is interconnected and depends on the presence of electronic measuring and computing devices, with which the original information is recorded and processed to output digital data to the user. The analysis of the main features and aspects of each system showed that quality of life actively permeates both urban and rural environments. Cities are nodal points for public services such as security, health, sanitation, electricity, water, etc.

Quality of life is multidimensional and depends on the level of satisfaction of basic needs, safety requirements, socialisation and psychosocial factors.

The authors in [48] consider how quality of life can be achieved in future smart cities today and confirm this with reports on quality of life practices in a smart city. Thanks to the technological revolution, there is a significant economic upswing among the population, which is willing to spend it on improving their quality of life.

It describes how corporate giants need to collaborate with local city builders or property developers so that builders can gain up-to-date knowledge about the use of new IP technologies to improve the efficiency of the city in future urban spaces. These include smart cards for ubiquitous access, video surveillance systems, IP cameras for citizen security, object authentication and event monitoring, and RFID, GIS and GPS for logistics and transport.

This section of the Master's thesis describes and considers the possibility of using information technologies with elements of electronic devices for collecting information (sensors). The main disadvantages are identified, namely: sensors are powered by a battery and belong to energy-intensive devices with limited battery

life; the amount and accuracy of information directly depend on the limited battery life, which is prone to discharge over time; the battery life should ensure the reliability of uninterrupted operation of interconnected devices; some possibilities of using sensors may be limited or inaccessible. Therefore, a significant disadvantage of using information technology in combination with IoT devices is the presence of outdated digital devices that need to be improved and new solutions to provide a smart city with uninterrupted monitoring. In addition to the elements of the Internet of Things, the article considers a comprehensive fog architecture with the described principle of transmitting indicators, which consists of three levels (cloud, fog and edge), and also describes the possibilities of using methods of encrypting information of the Internet of Things on cybersecurity issues to increase the level of protection during information processing.

On the basis of the analysed sources, the peculiarities of the use of information technologies and electronic devices - carriers of the Internet of Things with the possibility of developing a combined smart city system were determined, where the set of criteria of each smart technology was considered separately. The results of the study demonstrate the impact of the combined smart city system on the improvement of the quality of life, which is explained by the determination of compliance with the needs and conditions of the population. Thus, the set of criteria of each smart technology makes it possible to transform the city into a common combined system with digital service for the provision of services. From the obtained results and the formed scientific novelty, it can be argued that the smart technology systems meeting the needs of the population can serve for further research on the creation of a digital model of the city of the future with the involvement of appropriate software.

1.2. Comparative analysis of methodological approaches for the evaluation of smart cities

Growing urbanisation, along with geo-economic changes, demographic shifts, the growing importance of technology, digitalisation, intellectualisation, climate

change and resource scarcity, is one of the most important long-term trends with a significant impact on various sectors of society - a megatrend that creates new opportunities but also determines radical changes and challenges.

The content analysis of the sources [69 - 65] suggests that: the share of the world's population living in cities has already increased by more than 2.5 times between 1950 and 2021, reaching more than 56% in 2021 and projected to exceed 62% in 2050; urbanisation processes are characterised by significant asymmetry and disproportionality.

During the period 1950-2020, the highest level of urbanisation is observed in countries with a high level of socio-economic development - 81.9% of the population of countries in this group in 2020; the lowest level is observed in countries with a low and below-average level of socio-economic development - on average 33.2% and 41.6% of the population of countries in this group in 2020, respectively. In the macro-regional dimension, the highest level of urbanisation is found in the Americas, especially North America, with 82.6% of its population living in cities in 2020; the lowest is found in Africa, with 43.5% of its population living in cities. In the period 2020-2035, urbanisation will be fastest in countries with low and below-average socio-economic development - the growth rate of urbanisation in these groups of countries will be 24% and 20% respectively; Asia and Africa - the growth rate of urbanisation in these groups of countries will be 16% and 17% respectively; the least dynamic - 4% - in countries with high socio-economic development; Oceania and the Americas - 2% and 4% respectively; the number of cities worldwide has doubled in the period 1975-2020 to more than 14,000 by 2021 and is projected to increase by at least 1.5 times by 2030. 5 times by 2030; since the early 2000s, there has been a steady trend towards urban consolidation and population concentration in large cities.

For example, in 2016 there were 31 megacities (population over 10 million) in the world, with 6.8% of the world's population; 45 very large cities (population 5-10 million) - 4.2% of the world's population; 436 large cities (population 1-5 million) - 11.6% of the world's population; 551 medium-sized cities (population 500

thousand - 1 million) - 5.1% of the world's population. According to UN forecasts, in 2030 the world will have 41 megacities - 8.7% of the world's population; 63 very large cities - 5.2% of the world's population; 558 large cities - 13.4% of the world's population; 731 medium-sized cities - 6% of the world's population; - cities are the main drivers of socio-economic development and growth, they generate more than 80% of the world's GDP, are attractive investment targets, contribute to the development of economic activities and solve a number of socio-economic problems, including unemployment, income growth, etc. At the same time, global waste production is projected to increase by 70% by 2050.

Taking all of the above into account, urbanisation increases the pressure on urban and natural ecosystems and thus constitutes the largest pool of obstacles to the achievement of the Sustainable Development Goals by the global community, in particular Goal 11 "Sustainable Cities and Communities" [69]. Under these conditions, at the current stage of development, urban development management requires a significant revision and transformation.

The content analysis of the sources [69-39] suggests that one of the most promising concepts on the basis of which the principles and methods of urban development management should be revised and transformed is Smart Cities.

The purpose of this subsection is to provide a comparative analysis of the most representative and authoritative studies and methodological approaches to the analysis and evaluation of smart cities (studies and approaches of the International Institute for Management Development and the consulting firm A.T. Kearney), and to identify the leading and outsider cities of smart transformation.

The content analysis of the sources [69-39] suggests that - At the present stage, there is no generally accepted approach to understanding the essence of the concept of "smart city", but most often this concept is understood as an urban area where information and telecommunication technologies are actively used, data is collected, analysed and processed in order to improve the quality of life, ensure sustainability and efficiency of the city's functioning;

- Under the influence of the growing scientific and practical interest in smart cities in the second decade of the 21st century, the development of smart cities is becoming institutionalised. For example, in the second decade of the twenty-first century, A new urban development programme proposed by UN-Habitat [73]; a number of international standards on smart cities, in particular ISO/IEC 30182:2017 "Smart city concept model. Guidelines for creating a data interoperability model"; ISO/IEC 30145-1:2021 "Information technology. ICT Reference Framework for Smart Cities.

Part 1: Smart city business process framework"; ISO/IEC 30145-2:2020 "Information technology. ICT Reference Framework for the Smart City.

Part 2: Smart City Knowledge Management Framework", etc [70];

- Despite the institutionalisation of smart city development, there is no consensus on the number of smart cities in the world - according to different estimates, the number of smart cities in the world varies between 500 and 2500;

- the most representative studies, authoritative methodological approaches to the assessment of smart cities are: the approach of the International Institute for Management Development (IMD) - IMD Smart City Index and the approach of the consulting company A.T. Kearney (ATK) - Global Cities Index.

IMD has been ranking smart cities since 2019. As of 2023, 141 cities are included in the MIRM study. The methodology used by the above-mentioned international institute to assess smart cities has been revised several times, most recently in 2023. According to the updated methodology, the IIRC assesses cities based on data on the Human Development Index of the countries in which the cities are located and its four components (life expectancy at birth, life expectancy, average years of schooling, GNI per capita), as well as survey results. According to the Human Development Index, the MIRM classifies cities into four groups, with Group 1 (the first quarter of cities in the Human Development Index - cities with the highest Human Development Index) and Group 4 (the fourth quarter of cities in the Human Development Index - cities with the lowest Human Development Index). Within each of the 4 groups, the comparative position (score) of a city is determined

on a 10-dimensional scale - the AAA - D scale, where AAA is the best score and D is the worst.

According to IMD, Group 1 cities are rated in the range of AAA-BB on the 10-dimensional scale above; Group 2 - A-CCS; Group 3 - BB-C; and Group 4 - CCC-D. As mentioned above, IMD also uses the results of a survey of respondents - expert data - to assess Smart Cities. Based on IMD 's expert assessments:

- Priority areas for smart city development are identified. IMD experts ask respondents to identify 5 out of 15 areas of urban development that are the highest priority for the city in which they live.

The 15 urban development priorities identified by residents include: housing affordability, full employment, unemployment, health services, traffic congestion, pollution, green spaces, public transport, primary education, basic amenities, civic participation, waste recycling, social mobility, security and corruption. The city's development priorities are determined on the basis of generalisation and analysis of respondents' answers;

- Identifying the dominant social attitudes in Smart City societies. IMD experts ask respondents to assess three key aspects of privacy (willingness to share personal data, use of facial recognition technology, and the impact of increased transparency of local authorities on the Internet on trust in them) and the share of daily cashless payments;

- Assess the level of development of smart cities. In order to assess the level of development of smart cities, IMD experts use two groups of parameters: structural (allowing to assess the level of infrastructure created in the city) and technological (allowing to assess the technological support and services available to residents), within which the assessment is carried out in the following 5 thematic areas: health and safety, mobility, activities, opportunities (work and study) and governance. The list of indicators for each group within these thematic areas will be defined separately.

The results of the Smart Cities assessment carried out by IMD are presented in 2 formats: the position of the city in the ranking (in 2023 - 1-141), the rating of

the city on a 10-dimensional scale based on the integral value of the indicator and by the groups of indicators for which the assessment is carried out.

In 2023, according to MIRM, the most successful cities in terms of smart transformation will be Zurich, Oslo, Canberra, Copenhagen, Lausanne, London, Singapore, Helsinki, Geneva and Stockholm (Table 1.5.).

Table 1.5.

IMD Smart City Index

City	Year			
	2019	2020	2021	2023
Zurich	1	1	1	1
Oslo	2	2	2	2
Canberra	-	-	-	3
Copenhagen	4	3	5	4
Lausanne	-	-	4	5
London	3	10	3	6
Singapore	10	7	7	7
Helsinki	6	5	9	8
Geneva	7	8	6	9
Stockholm	9	9	11	10

Source: Author's compilation based on [36].

The least successful cities in terms of smart transformation are Guatemala City, Sanaa, Beirut, Accra, Tunis, Rio de Janeiro, etc (Table 1.6.). The consulting firm A.T. Kearney (ATK) has been evaluating smart cities since 2008. As of 2023, A.T. Kearney provides information on the status and characteristics of smart transformation in 156 cities. Based on the results of its research, ATK provides information not only on the current level of development of smart cities - Global Cities Index (GCI) - but also on their prospects for further development - Global Cities Outlook (GCO) [39].

(Table 1.6.)

Leading and Outsider citiesin the IMD Smart City Index

City	2023			
	IMD Smart City Index		Components of IMD Smart City Index	
	place	evaluation	evaluation	evaluation
Leading cities				
Zurich	1	AAA	AAA	A
Oslo	2	AAA	AAA	A
Canberra	3	AA	AA	A
Copenhagen	4	AA	AAA	A
Lausanne	5	AA	AA	A
London	6	A	BBB	A
Singapore	7	A	A	A
Helsinki	8	AAA	AA	A
Geneva	9	AA	AA	A
Stockholm	10	A	A	A
Outsider cities				
Guatemala	141	D	D	D
Sanaa	140	D	D	D
Beirut	139	D	D	D
Accra	138	D	D	D
Tunisia	137	D	D	D
Rio de Janeiro	136	D	D	D
Amman	135	D	D	D
Lima	134	C	C	C
Abuja	133	D	C	D
Lagos	132	D	D	C

Source: Author's compilation based on [36]

The analysis and assessment of the current level of Smart City development (GCI) is based on 5 groups of indicators (business activity, human capital, information exchange, cultural experience and political participation), which combine 29 metrics. Each of the groups of indicators, on the basis of which the ATK calculates the Integrated Smart City Development Indicator, is characterised by a specific weighting factor. The highest weighting factors - 0.3 - are used for 2 groups of indicators: business activity, human capital; the lowest - 0.1 - is used for the group reflecting political participation; for comparison, the weighting factor of 0.15 is used for 2 groups of indicators: information exchange, cultural experience.

The ATC analyses and assesses the prospects for the further development of Smart Cities (GCO) on the basis of 13 indicators divided into 4 groups: personal well-being, economy, innovation and governance. Each of the 4 groups of indicators is characterised by equivalent weighting factors of 0.25. The integral indicators GCI and GCO range from 0 to 100, with 0 being the minimum and 100 the maximum.

The methodological approaches of IMD and ATK to the analysis and assessment of smart cities are thus characterised by both similarities and differences (Table 1.7.).

Table 1.7.

Comparative analysis of the most authoritative and representative smart city evaluation approaches

Comparison parameters	IMD Smart City Index	Global Cities Index	
Organization conducting the research	International Institute for Management Development	A.T. Kearney Consulting Company	
Partner Organization	World Smart Cities Organization	-	
Location of the institute	Lausanne, Switzerland	Chicago, USA	
Year of the research	2019	2008	
Frequency of research	Annually	Annually	
Periodical publication name	IMD Smart City Index Report	Kearney's Global Cities Report	
		Global Cities Index ranking	Global Cities Outlook ranking
Dimensionality of the evaluation scale	0-100 (basic), where 0 is the minimum score, 100 - the maximum; letter (additional), where AAA is the best grade, D - the worst.	0-100, where 0 is the minimum score, 100 - the maximum	
Number of cities in scope of the study (2023)	141	156	
Subject of research	Successfulness of cities in terms of economic development, human capital, technology	Current capacity of cities to generate, attract and retain capital, people and ideas	Prospective capacity of cities to generate, attract and retain capital, people and ideas
Number of groups of factors, that are taken into account	2	5	4
The total number of parameters (indicators) used to assess the development of smart cities.	44	29	13
Features of the Smart City rating methodology	Smart city assessments mainly use expert data; focus on residents' perceptions of cities	Smart city assessments mainly use statistical data; focus on urban development parameters	

Source: Author's compilation based on [36; 39]

By 2023, the most successful cities in terms of smart transformation, according to the APC, will be New York, London, Paris, Tokyo, Beijing, Brussels, Singapore, Los Angeles, Melbourne, Hong Kong; the least successful are Surat, Abha, Mecca, Medina, Tangshan, Yangon (Rangoon), Dongguan, Yantai, Quanzhou, Bandung (Table 1.8.).

Table 1.8.

A.T. Kearney Global Cities Index

City	Year			
	2019	2020	2021	2023
Leading cities				
New York	1	1	1	1
London	2	2	2	2
Paris	3	3	3	3
Tokyo	4	4	4	4
Beijing	9	5	6	5
Brussels	12	14	16	6
Singapore	6	9	9	7
Los Angeles	7	7	5	8
Melbourne	16	18	12	9
Hong Kong	5	6	7	10
Outsider cities				
Surat	133	146	156	156
Abha	-	151	151	155
Mecca	-	150	153	154
Medina	-	149	154	153
Tangshan	135	145	155	152
Yangon (Rangoon)	127	137	143	151
Dongguan	132	143	150	150
Yantai	131	141	149	149
Quanzhou	134	144	152	148
Bandung	118	136	145	147

Source: Author's compilation based on [39]

By 2023, ATC estimates that the cities with the greatest prospects for further smart transformation are San Francisco, Copenhagen, London, Luxembourg, Paris,

Dublin, Helsinki, Stockholm, Munich, Singapore; the lowest - Caracas, Tehran, Kinshasa, Lagos, Kyiv, Khartoum, Dhaka, Beirut, Accra, Luanda (Table 1.9.).

Table 1.9.

A.T. Kearney Global Cities Outlook

City	Year			
	2019	2020	2021	2023
Leading cities				
San Francisco	3	11	25	1
Copenhagen	17	20	21	2
London	1	1	1	3
Luxembourg	-	17	11	4
Paris	5	5	2	5
Dublin	9	10	5	6
Helsinki	-	38	43	7
Stockholm	10	8	6	8
Munich	8	6	3	9
Singapore	2	3	10	10
Outsider cities				
Caracas	133	151	156	156
Tehran	123	140	150	155
Kinshasa	130	149	153	154
Lagos	134	150	154	153
Kyiv	-	94	94	152
Khartoum	131	147	152	151
Dhaka	135	148	155	150
Beirut	-	122	137	149
Accra	127	145	146	148
Luanda	132	146	144	147

Source: Author's compilation based on [39]

Taking all of the above into account, the IMD s and APK's top 10 smart cities differ significantly. Despite the significant differences between the IMD and APK lists of the top 10 smart cities, the top 10 smart cities of these international institutions consistently include London, Singapore, Stockholm and Copenhagen, so the experience of developing these smart cities should be taken into account when identifying promising areas for transforming cities into smart cities.

For example, a comparative analysis of the methodological approaches to assessing smart cities used by the International Institute for Management

Development and the consulting firm A.T. Kearney showed that they differ significantly in terms of

- the list of complex indicators used to determine the integral indicator of smart city development

- the assessment of smart cities (IMD - structure and technology; ATK - GCI: business activity, human capital, information exchange, cultural experience and political participation; GCO: personal well-being, economy, innovation, governance)

- the number of complex (IMD - 2; ATK - 9) and single indicators used to calculate the integrated smart cities indicator (IMD - 44; ATK - 42);

- The ratio of statistical and expert data used to assess smart cities (IMD - mainly expert data; ATK - mainly statistical data);

- the focus (IMD - focuses on residents' perceptions of cities; ATK - focuses on urban development parameters);

- the number of cities covered by the study (IMD - 141 cities; ATK - 156 cities).

Taking all these factors into account, and despite the fact that the approaches of these two international institutions are the most representative and authoritative at the current stage of development, the most comprehensive approach to assessing smart cities is the ATC approach.

1.3. Analysis of the impact of a smart city on the region: case from US

Projects to introduce technology into the urban environment exist in all regions of the world, and in recent years have been particularly relevant in China. In order to develop smart cities, it is necessary to study the examples of other countries, analyse the problems that arise in the course of implementation, and formulate our own approaches to the vision of a truly smart city. One of the acknowledged leaders

in this field is the USA. According to Juniper Research, the top 5 smartest cities in the world are New York, San Francisco and Chicago. The US experience, both positive and negative, can be useful in understanding the current state of the smart city phenomenon. Using the example of the Metropolitan Statistical Areas (MSAs) of the continental states, geographical patterns of efficiency in the implementation of urban technologies have been analysed.

The information and statistical base of the study was provided by the U.S. Bureau of Statistics, Bureau of Labour Statistics, Federal Communications Bureau, U.S. Patent and Trademark Office, U.S. National Science Foundation, and the National Conference of Commissioners on Unification of State Legislatures.

The lack of demand for technology is one of the main problems of modern smart initiatives. The example of the IBM project in Philadelphia shows that in order to use innovation effectively, it is necessary to take into account the capacity of a given community to implement technological solutions [79].

Thus, a deliberate refusal to implement based on lack of readiness can be a positive signal. However, there is a political factor at play here. On the one hand, public authorities should develop and support the innovation environment; on the other hand, they should protect residents from the excessive influence of technology companies. In San Francisco, for example, Uber was forced to stop testing unmanned cars due to the lack of a special government permit [61]. In some ways, this can be seen as a negative government influence on the development of technology. However, a closer look at examples of the use of drones reveals that it is a preventative safety measure. The example of the unmanned shuttle launch in Las Vegas shows that neither roads nor city dwellers are ready for autonomous transport [68].

The emergence of autonomous transport raises the question of the legal side of the introduction of urban technologies: who will be responsible for an accident involving a drone? A new task arises - the formation of technology policy, i.e. a strict understanding of when a machine can be trusted and which areas of life are better left under human control. This becomes particularly important with the

development of artificial intelligence, when the relationship between machines and humans needs to be regulated.

By delegating some of its functions to innovation, government is ensuring the development of a society in which power belongs to machines. By critically analysing innovations, government can limit the influence of technology on the processes of urban management. An example of this measured approach to technological innovation is the ban on Uber. In December 2017. The European Court of Justice recognised Uber as a transport company rather than a technology company [6]. This means that the service is now obliged to comply with the general rules governing the provision of taxi services in each EU country.

According to the definition of the Bureau of Statistics, a newly born enterprise is defined as an enterprise that has started its activity within the last year. In other words, the classification is not based on the type of employment but on the age of the enterprise. Nevertheless, the use of this indicator in the final index is valid because it shows the level of entrepreneurial activity without which the introduction of urban technologies is currently impossible. In addition, the employment indicator for start-ups is used in the well-known EasyPark Smart Cities Index.

Examples of successful local startups can be found in San Francisco. The first Uber rides were made in San Francisco in 2010, and the company then began its active expansion in cities around the world. The city also has one of the most successful parking systems in the country, SFPark [37]. Using meters and sensors, a special programme monitors the availability of free parking spaces and adjusts the price according to demand. The system proved effective, and other cities began to adopt the experience. Seattle, for example, created a similar application called SeaPark [37].

Parallels can be found between the obtained distribution of factors and complex theoretical models of a smart city. The proposed interpretation of the results of the factor analysis (science, demography, economy and law, infrastructure) is a kind of synthesis of several variants of the academic disclosure of the concept. P. Lombardi has drawn up a scheme based on G. Itzkowitz's theory of the triple helix

of innovation production [46]. In their view, the smart city is the result of the interaction of four vectors: industry, government, university and society. T. Nam and T. Pardo proposed a variant consisting of urban society, government and technology [55]. Both complex definitions and this paper consider the impossibility of an effective implementation of urban technologies considering only one direction: each factor separately is a necessary but insufficient condition for a smart city.

Describing the essence of the phenomenon using this method allows us to state that the Smart City Index is a dependent variable of the interaction of all four factors. The leading agglomerations will have the most favourable combination of factors. Assessing the strength of each component allows us to know the strengths and weaknesses of a particular place, which in turn allows us to define a strategy to increase the Smart City Index.

The calculation uses variables that range from 0 to 1. Accordingly, the final index takes values between 0 and 8. According to the index values, the metropolitan areas are classified as follows.

as follows:

- high (more than 4.6);
- above average (2.8-4.6);
- average (2.2-2.8): 2.22 is the average index value for the USA;
- below average (1.7-2.2);
- low scores (less than 1.7).

The maximum index value was 5.4 (San Jose) and the minimum was 0.9 (Lima, Ohio). A two-colour scale was chosen for the figure (Figure 1.3) to make it easier to identify above-average values (shades of red) and below-average values (shades of blue).

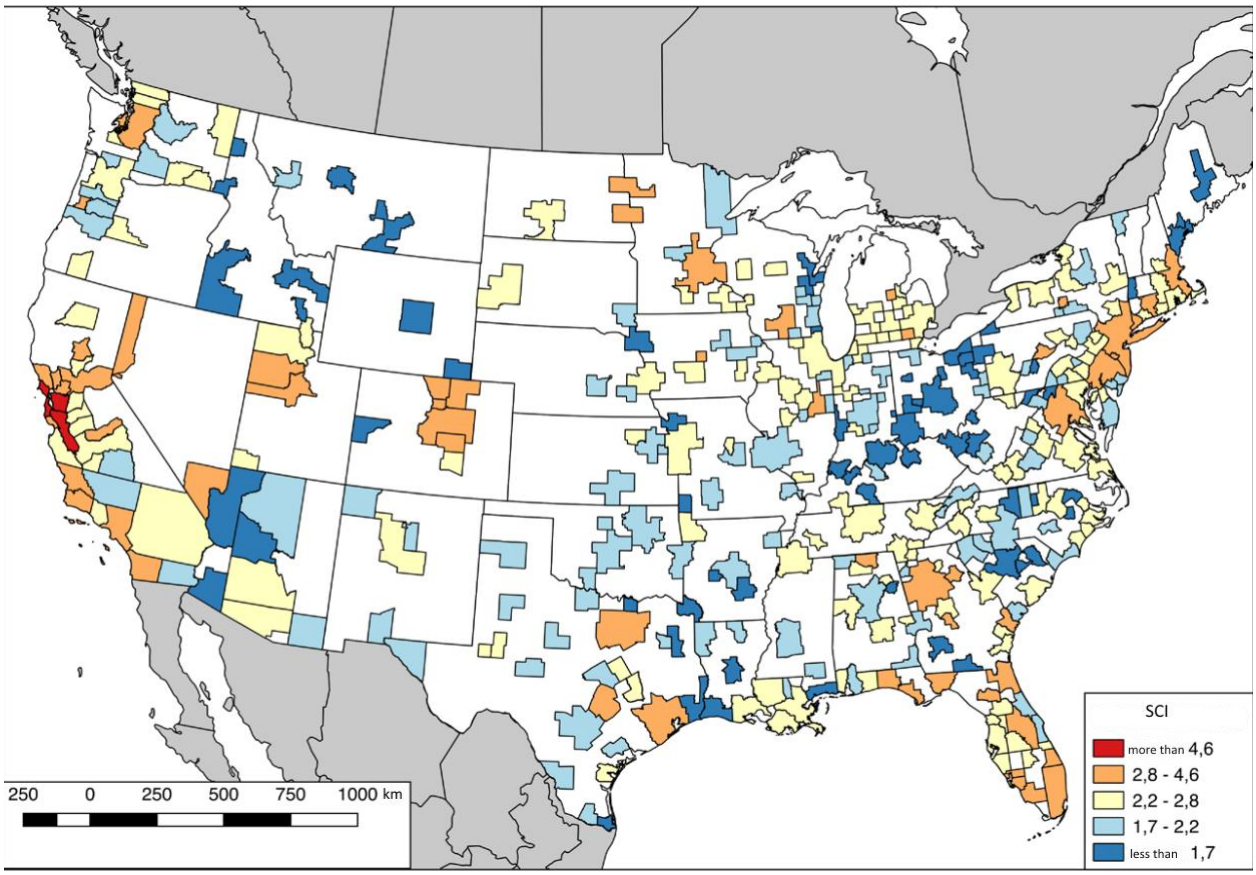

Figure 1.3 – Smart City Index by metropolitan area of the contiguous United States

Source: Author's compilation based on Map base data: © OpenStreetMap project members

The resulting distribution is normal. This allows us to use the index values to interpret the efficiency of technology implementation in US cities.

We analysed the relationship between the Smart City Index and the Florida Creativity Index [25] and GDP per capita by calculating correlation coefficients. The indicators were chosen to reflect the development of human capital (at the same time directly related to technology, as the Milken Institute Technology Index is used in the calculation of creativity) and regional economic development, respectively. An average level of correlation was found between 0.4 and 0.5 with both variables. The results obtained can be interpreted as a confirmation of the comprehensiveness of the approach to the adaptation of urban technologies.

In other words, a high level of wellbeing and creativity of the city's inhabitants have an equal impact on the desired characteristic, i.e. the processes of effective innovation implementation do not depend solely on the city's ability to acquire or produce technology. Otherwise, a high correlation coefficient of the Smart City Index with any indicator would reflect a direct linear relationship and negate the significance of other variables in the analysis.

The next step is to break down the distribution of each class across the US.

1- Leaders.

At the top of the ranking are the agglomerations of San Jose and San Francisco (Table 1.10.). It is assumed that here there is an almost benchmark attitude towards technological urban initiatives.

2. Above average scores.

This group included most of the country's research centres, such as Boulder, Seattle, Madison, Austin, Dallas, Houston. The potential for effective implementation of urban technologies is also observed in large agglomerations such as Atlanta, Miami, Denver, New York, Minneapolis-St. Paul.

The following trend can be observed: cities with above-average 'smartness' scores are scientific centres that are also centres for the production of information services, communications equipment, computers and peripheral equipment (Table 1.10.).

Table 1.10.

Ten US metropolitan areas with the highest smart city indices

Rating	**Metropolitan area**	**Index**
1	San Jose - Sunnyvale - Santa Clara, California	5,36
2	San Francisco - Oakland - Hayward, Calif.	4,56
3	Boulder, Colorado	3,98
4	Ann Arbor, Michigan	3,64
5	Santa Maria - Santa Barbara, Calif.	3,59
6	San Diego - Carlsbad, CA	3,47

Rating	Metropolitan area	Index
7	Santa Rosa, California	3,39
8	Huntsville, Alabama	3,36
9	Tallahassee, FL	3,34
10	Seattle - Tacoma - Bellevue, WA	3,34

Source: Author's compilation

3. Average index values.

This class is concentrated in the area of the industrial Lakeside - from Chicago to Detroit. A compact arrangement of agglomerations with the considered value is also characterised by the Louisiana coast: the metropolitan areas of Baton Rouge, New Orleans, Lafayette, Thibodaux.

The group is dominated by industrial cities. In addition to the listed areas, Pittsburgh, Buffalo, Phoenix and Charleston belong to this class. To confirm the hypothesis about the relationship between the value of the Smart City Index and the development of industrial production, the ISA ranking was analysed by the share of the working class. It turns out that the top ten metropolitan areas (according to the US Census Bureau) have average Smart City Index scores.

The cities of the Research Triangle in North Carolina were also included in the same group: this is due to the fact that the infrastructure factor in the innovation centre is declining - low values for internet connection capacity are observed.

4. Below average scores.

Below-average quantitative scores on the Smart City Index are concentrated in West Texas, Oklahoma (the state stands out for the homogeneity of its Smart City Index score) and Missouri. A number of industrial centres are also in this class: St Louis, Wichita and Milwaukee.

5. Low scores.

The lowest opportunities for effective technology deployment are highly localised.

The first area with the lowest scores is in the industrial belt - Ohio, Kentucky and Indiana. The second is in Maine and the third in Idaho, Montana and Wyoming.

To illustrate the results of introducing urban technologies in areas with low index scores, consider the example of Arizona. The state allows unmanned vehicles to operate on public roads. However, this technocratic thinking has had tragic consequences: On 19 March 2018, there was a fatal incident between an unmanned Uber taxi and a person in Arizona [5].

The detailed analysis of the distribution of Smart City Index scores across US metropolitan areas allows us to make an assumption about their geographical patterns.

There is a close relationship between the index score and the development of the innovation economy. The innovation sector of the economy consists of two parts: high-tech industry itself (i.e. 'where high technology is applied') and knowledge-intensive services. The innovative services sector includes industries such as software production, computer systems design, various telecommunications and data processing.

In the context of urban technology production, the high-tech industry can be divided into

- Enabling (mainly computer and peripheral equipment manufacturing);

- those not related to the production of urban innovations (e.g. aircraft manufacturing, energy equipment).

Thus, by looking at the structure of the innovation economy, we can assume that

- the smart city index depends mainly on the development of the knowledge-intensive services sector, which is directly related to the processes of soft verification;

- in the process of effective implementation of urban innovations, it is not so much the specific production of a service or technical object that determines the balance between research and development and production output.

While high scores on the index are confined to places with parallel development of science and innovative services, medium and below-average scores on the Smart City Index prevail in cities where only one of these elements is developed. Either there are institutions that generate scientific knowledge and no industrial production, or industrial innovation production dominates R&D and does not determine the development of urban technologies. For example, New Haven, home to Yale University, and Phoenix and St. Louis, considered important innovation centres but specialised in the aerospace industry, are at the top of the Smart City Index.

The analysis of the geographical distribution of the Smart City Index thus reveals the following pattern: at present, the development of material production in the US is generally not conducive to the effective introduction of technologies. On the contrary, the development of the urban economy under the influence of information and knowledge (creation of post-industrial economy, knowledge economy) facilitates the process of innovation implementation.

In addition to the economic basis, the mutual position in the geographical and social space of the country is also significant. Such an assumption can be made on the basis of comparing the areas with high values of the Smart City Index with the megaregions of R. Florida [25]. Thus, Cascadia, Boswash, the Florida megaregion, Dal Austin, Northern and Southern California all have high scores. Geographical concentration currently predetermines the opportunities for the development of urban innovations, and the more complex the implemented urban technology, the more the effectiveness of its implementation depends on the characteristics of the location, the more important it is to take these characteristics into account in the implementation.

Due to the transformation of everyday practices under the influence of ICTs, the study of urban technologies should not consider the physical presence of technologies, but the process of changing the urban environment and urban lifestyle.

As a result of the comparison of the results of the conducted factor analysis of the variables selected for the quantitative assessment of the Smart City Index with

complex theoretical definitions of a smart city, the conclusion about the complementarity of the identified factors is drawn. A high value of one of the factors does not guarantee a high value of the final index. Each factor on its own is a necessary but insufficient condition for the effective implementation of urban technologies.

CHAPTER 2.
ANALYSIS OF FUNDING FOR THE DEVELOPMENT OF SMART CITIES IN CHINA

2.1. Smart city development in China

The development of smart cities in China can be divided into three main phases. The first stage (2008-2012) marked the introduction of the smart city concept. During this period, each industry independently promoted digital and intelligent transformation, which was generally a decentralised construction phase. The main feature of this stage is that each sector works independently, exploring how information technology can be used to improve efficiency and service levels.

In the second phase (2012-2015), China's smart city construction has evolved into pilot studies and standardised development. Under the guidance of the inter-ministerial smart city coordination working group, various business application industries have started to experiment with partial linking and sharing, which indicates that smart cities have moved to a more standardised development stage. The key during this period is to facilitate collaboration and information sharing between different departments and business areas.

The third phase began in 2016 and represents a comprehensive, iterative update of smart city development concepts, construction ideas, implementation pathways, operational models and technical tools. Smart city construction in this phase has entered a new phase of smart city development with a focus on people-centricity, outcomes, integrated adoption and collaborative innovation. The focus of development has shifted to coordinating the planning of smart urban facilities and building common platforms, solving the problem of data islands, strengthening urban-rural coordination, and forming an integrated working model. Figure 2.1 shows the stages of smart city development in China

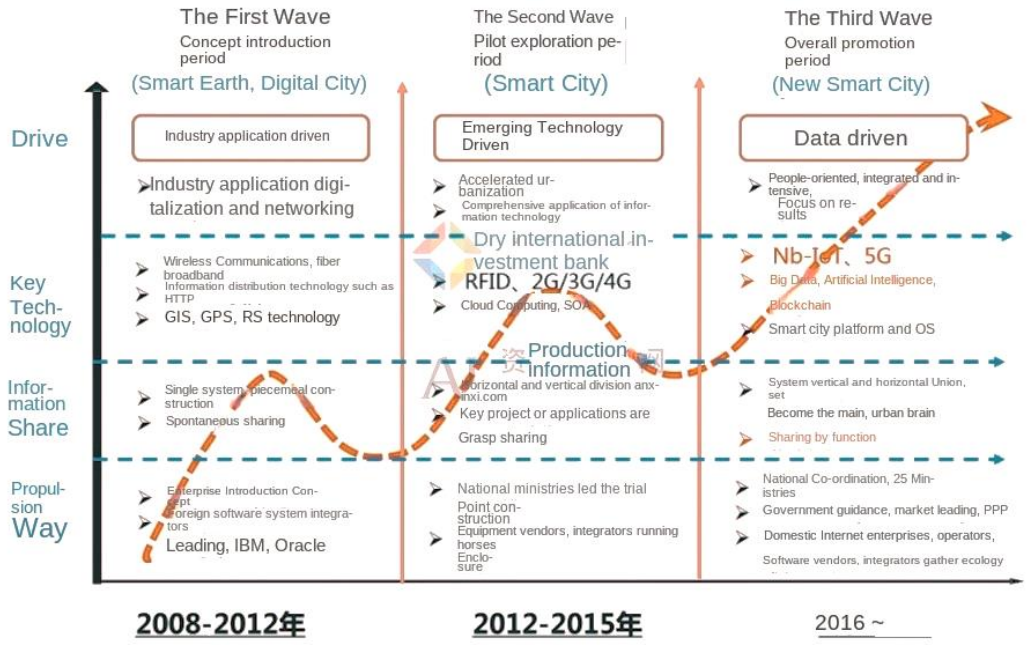

Figure 2.1 – Stages of smart city development in China

Source: Asset Information Network Qianji Investment Bank China Academy of Information and Communication Technology [53]

In terms of implementation effects, the combination of new technologies such as 5G, big data and artificial intelligence has promoted the creation of smart city networks and intelligence, and created a number of new models and new business formats. These changes have brought more popular and practical smart services to people, and improved the sense of reality of smart cities.

As the main carrier of Digital China construction, China's smart city construction is developing rapidly. The new smart cities have not only become an important way to improve government capacity and public service level, but also play an important role in the development and expansion of the digital economy. The following are three main characteristics of the current development of smart cities in China:

Policy guidance. A number of national-level policies, such as the 'Fourteenth Five-Year National Economic and Social Development Plan of the People's Republic of China and the Long-Term Goal Framework to 2035', provide clear

guidance on building smart cities. The report of the 20th National Congress of the Communist Party of China emphasises the goal of building a 'livable, sustainable and intelligent city'. In addition, policies issued by various national ministries and commissions guide the development of new urbanisation, urban-rural integration, urban infrastructure construction, smart communities and grassroots governance.

Driven by technology: The use of digital technologies has given new impetus to smart cities. 5G technology plays an important role in the construction of smart cities. It is deeply integrated with technologies such as big data, artificial intelligence, cloud computing and digital twins, bringing innovation to transport, security, public affairs and other areas. The construction of city brains is moving from a single intelligent system to an intelligent system in both vertical and horizontal dimensions. Digital twin technology enables a new model of urban governance by integrating many types of data.

Urban development in districts and counties: In 2022, the central government issued the "Views on Promoting Urbanisation Construction with County Cities as an Important Carrier", which stressed the importance of developing smart counties. County cities in various regions are promoting smart city construction through smart infrastructure transformation, industry optimisation and upgrading, and smart upgrading of grassroots management. According to the China Academy of Information and Communication Technology, 52.3% of county cities will have developed top-level smart cities by 2021, and the proportion is expected to reach 80% by 2025.

The construction of smart cities in China is developing rapidly, with the main axis being policy guidance, technology development and urban development of districts and counties. The market size continues to grow, and the depth and breadth of smart cities continue to expand. This not only reflects the maturity of China's smart cities, but also the huge potential for future urban development.

The smart city industry has a wide scope, many fields and long chains, involving many players, including ICT equipment suppliers, telecom operators, system integrators, software developers, Internet companies, financial companies,

and real estate and product companies as entry points, horizontally expanding its application fields, vertically penetrating and spreading to the upstream and downstream of the industrial chain, actively building the ecosystem, and expanding the territory and area in the smart city field.

The complete smart city ICT ecosystem includes partners in investment and financing, top-level design, integration, operation, business applications, ICT infrastructure, etc., combined with smart city architecture, selection of standards and specifications, top-level design, infrastructure and an intelligent centre. Enterprises with strong business representation in smart applications, operational services, network security and other business aspects form the industrial map of a smart city.

The operating models of China's smart cities are diverse and can be divided into three types: sole proprietorship, cooperative, and multi-party. Each of these models has its own characteristics and is suitable for different types of smart city projects.

The single-dominant operating model is mainly characterised by public funding or corporate investment. In this model, the government or enterprises are directly responsible for the construction, maintenance and operation of smart cities. The content and service model is defined by the sponsor, and service companies provide services and products as needed. This model is suitable for public infrastructure and other types of projects. Its advantages include rapid implementation and strong control by the government or leading companies. However, this model may limit the development of innovation and diversification.

The cooperative model mainly involves raising external capital for investment and construction. According to this model, after the project has been operating stably for a certain period of time, it can be returned to the government or enterprises, or the government and enterprises can jointly finance it to continue operation. The cooperative model is suitable for smart city projects with certain operational characteristics, such as high operational efficiency, large operational value-added potential, and broad funding sources. This model encourages private sector participation and helps to improve project innovation and market adaptation.

The multi-participation model is an operational method that involves the cooperation of several roles. In this model, the government and enterprises jointly finance the construction, or several parties jointly establish a smart city management company to be responsible for the day-to-day construction and operation management of the project. This model is suitable for projects such as smart communities and parks. It is characterised by strong public participation, diverse funding sources and a focus on social innovation and incubation. The multi-stakeholder model encourages collaboration between different stakeholders and helps to share resources and maximise integrated benefits.

At present, China's smart city operating model is dominated by the unilateral dominance model, followed by the cooperative model, with the multi-stakeholder model accounting for a relatively small proportion. Each model has its own advantages and limitations, and choosing the right operating model is crucial to the success of smart city projects.

The technological development of China's smart cities is progressing rapidly, covering a wide range of areas from infrastructure construction to the application of high-tech technologies. Progress and innovation in key technologies provide a solid foundation for the construction of smart cities. Among them, the Internet of Things (IoT), big data, cloud computing and artificial intelligence (AI) are key technologies driving the development of smart cities.

IoT technology plays an important role in smart cities. By connecting sensors and devices to the internet, IoT enables real-time monitoring and control of city facilities and services, such as intelligent transport systems, environmental monitoring and public safety systems. Big data technology is used to process and analyse the massive amounts of data collected in city operations to provide decision support and insights to optimise city management and services.

Cloud computing provides smart cities with powerful data processing and storage capabilities. It allows city managers to process complex data sets more efficiently and supports the operation of a variety of applications in smart cities. Artificial intelligence is increasingly being used in smart cities to improve the

efficiency and accuracy of city management, from intelligent traffic management to the automation of public services.

In addition, the introduction of 5G communications technology is providing smart cities with faster speeds and lower network latency, enabling the transfer and processing of large amounts of data in real time. The use of blockchain technology in smart cities, such as supply chain management and data security, is also growing.

With the continuous development and integration of these technologies, China's smart cities are becoming smarter, more efficient and more sustainable. These technologies not only increase the efficiency of city operations, but also significantly improve the quality of life for citizens.

In summary, China's smart city policy and regulatory framework is a comprehensive system led by the government, with the participation of industry associations and guided by standards. This system not only covers all aspects of smart cities, but also provides strong policy support and regulatory guarantees for the healthy and orderly development of smart cities.

In the financial analysis of China's smart city industry, the key is to adopt a comprehensive and dynamic methodology to accurately assess the financial position and growth potential of the industry. First, revenue and profit analysis provides a basic understanding of the industry's profitability. This involves estimating the revenue, profit and cash flow growth of smart city related companies. Second, cost structure analysis is critical to understanding the efficiency of the industry. By analysing direct and indirect costs, it is possible to identify the cost-effectiveness and potential savings of smart city projects.

In addition, return on investment (ROI) is a key indicator of the financial viability of smart city projects. When assessing ROI, it is necessary to take into account the cost of the initial investment, the cost of operations and maintenance, and the expected benefits of the project. In addition, risk analysis should not be overlooked. This includes the potential risks associated with policy changes, technological upgrades and changes in market demand. Equally important is an

analysis of market competitiveness, including factors such as market share, brand influence and customer loyalty.

Financial forecasting and budget management are key to ensuring the long-term success of the project. By forecasting industry trends, government policies and technological developments, combined with financial models, it is possible to make reasonable projections of future revenues and expenses for smart city projects. In addition, an analysis of capital structure and funding sources can help evaluate a company's financing mechanisms, including debt and equity ratios, financing costs, etc. Figure 2.2 shows the dynamics of several smart city financial indicators.

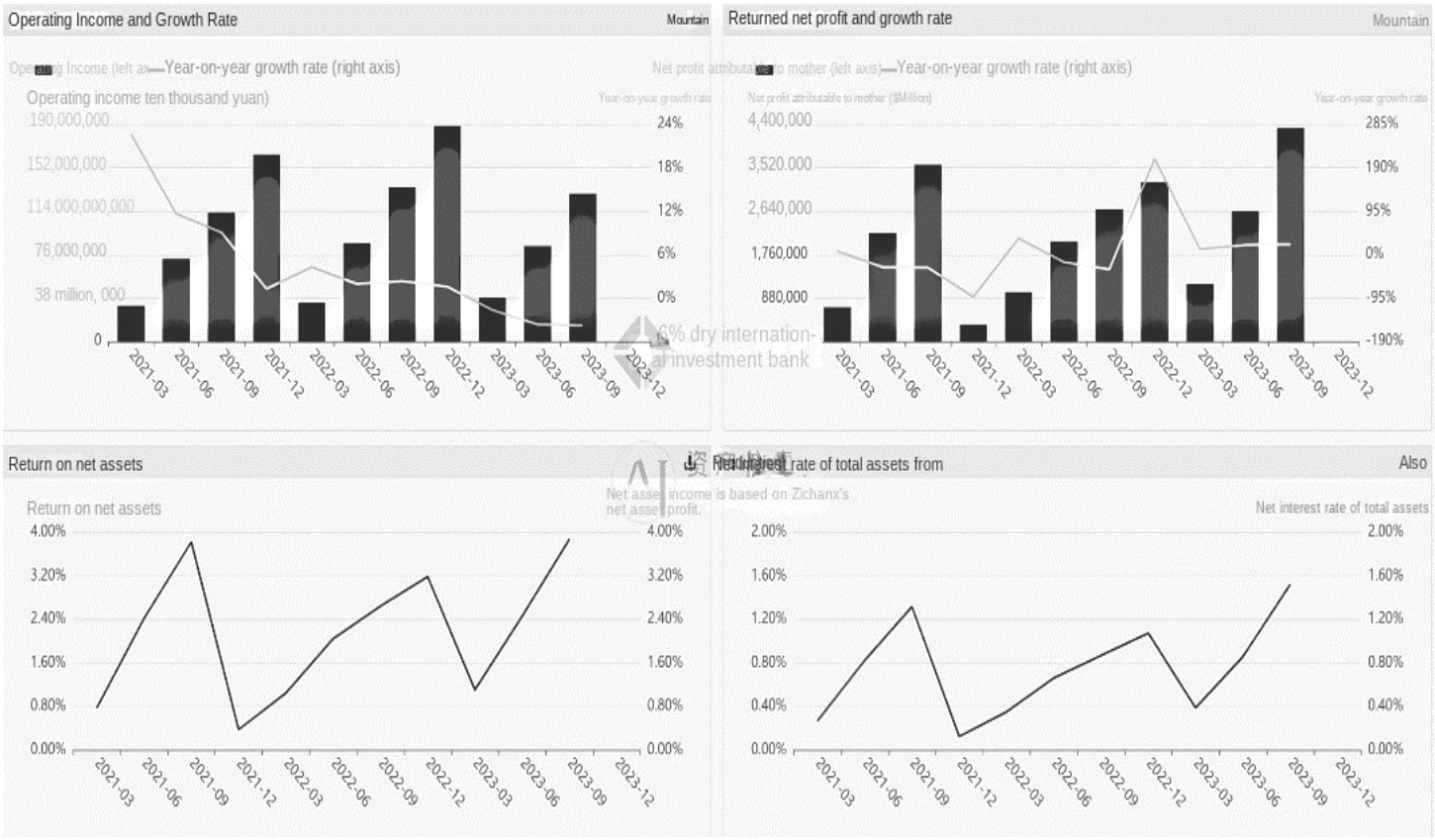

Figure 2.2 – Smart City Index

Source: Qianji Investment Bank's iFinD asset information network [57]

The valuation methods of the smart city industry can choose the price-earnings ratio valuation method, PEG valuation method, price-to-balance sheet ratio valuation method, market-to-current ratio valuation method, P/S price-to-sales ratio valuation method, EV/price-to-sales ratio valuation method, RNAV revaluation net asset value valuation method, EV/EBITDA valuation method, DDM valuation method, DCF discounted cash flow valuation method, NAV net asset value valuation method, etc. The dynamics of the above indicators is shown in Figures 2.3 -

Figure 2.3 – Smart City Index Financial data

Source: Qianji Investment Bank's iFinD asset information network [5757]

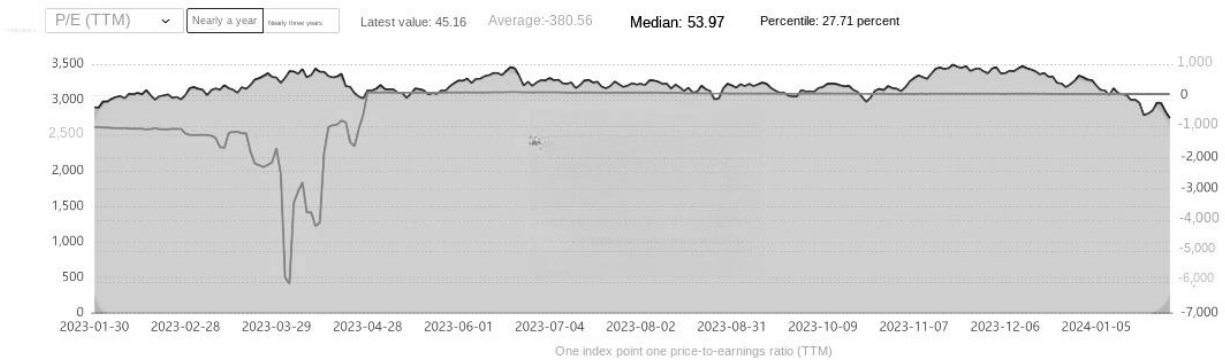

Figure 2.4 – Smart City price-earnings ratio

Source: Qianji Investment Bank's iFinD asset information network [57]

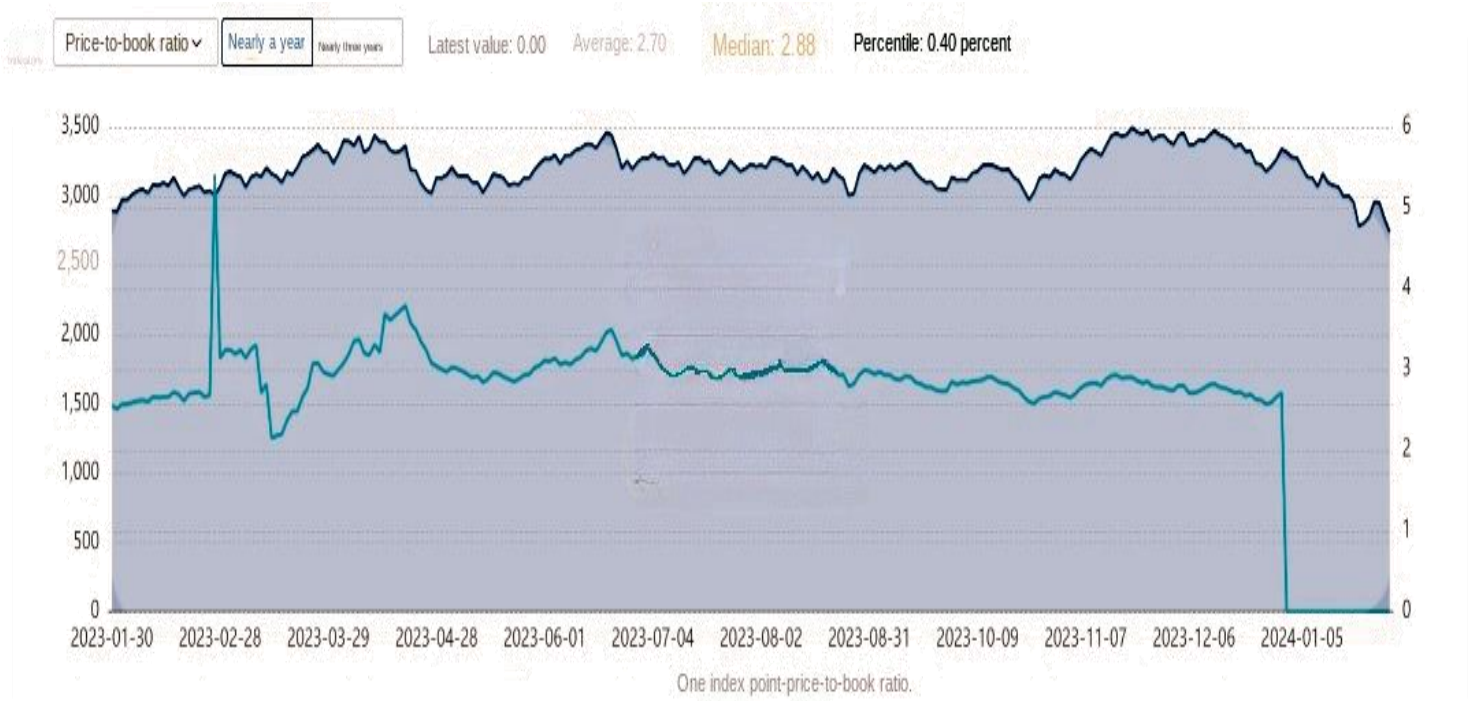

Figure 2.5 – Smart City price – to – book ratio

Source: Qianji Investment Bank's iFinD asset information network [57]

The rapid development of smart cities in China is driven by many factors, including the management of urban ontology, the management of urban internal environment and the management of urban external environment.

The pursuit of urban ontology is mainly reflected in the contribution of enterprises, especially foreign investment, to smart city construction. In the early stage of smart city construction, enterprises, especially foreign investors, play an important role in urban construction through cooperation with the public sector. Their investment not only provides financial support for the construction of urban infrastructure, but also contributes to the development of the urban economy. The participation of enterprises not only generates funds, but also introduces advanced management practices and technologies, injecting vitality into the construction of smart cities.

The urban internal environment mainly relies on the incentives of the innovation environment. Innovation is an important way to promote the development of smart cities, including innovation incentive systems, science and technology resources, and science and technology service systems. A robust innovation system can effectively promote scientific and technological progress and the generation of new ideas. Improving the intellectual property protection system is crucial to stimulating innovation power, and a high-level scientific and technological foundation is key to the development of smart city information technology and technological innovation.

External urban environment factors include regional cooperation and interaction between cities. The construction of a smart city is not isolated, but has a connecting effect between cities. The development experience of large cities can be used as a guide for small cities, and by sharing experiences and resources, cities can jointly promote the construction of smart cities in the region. Regional cooperation not only improves the functions and efficiency of smart cities, but also strengthens the links between cities and promotes the coordinated development of the whole region.

Table 2.1.

General risk factors

Risk Factor 1	Risk Factor 2	Risk Factor 3
Penalties or revocation of qualifications for violations of laws and regulations, prosecution of major Or lost, regulatory letters, fraud, asset freezes	Founder or executive scandals and crimes to be investigated, filed	Deterioration in performance, loss forecast for large orders, Failure to report on time, failure to pay debts
Major Malignant Product Service Security Incidents	Short rumors, worsening public opinion, extreme bubble	Valuation downgrades and rating downgrades; Significant components Excluded from Index
Policy deterioration, policy negative, elimination of subsidies, higher taxes And tighter regulation	Financial failure, external guarantee misdeeds, controller change Even worse, equity pledge burst, bet failed.	Natural disasters, wars and uncontrollable events Born
Unlocked sell-off control collapse Executives reduce large Holdings	The macro environment deteriorated and financial markets plummeted. Corresponding commodities Prices plummet	Layoffs, bankruptcy, implementation of ST or delisting
Industry Deterioration, New Technologies, and Industry Substitution	IPO, financing, issuance, asset sale, M & A backdoor Such as termination or failure	.....

Source: Qianji Investment Bank's iFinD asset information network [57]

We believe that the development of smart cities in China is a complex process driven by several factors. Corporate investment, the innovation environment and regional cooperation together form the three pillars that promote the development of smart cities. In the future, as these factors continue to deepen and integrate, it is foreseeable that China's smart cities will further accelerate their development and achieve smarter, more efficient and sustainable urban governance.

Despite the rapid development of smart cities in China, it still faces many risks and challenges.

Another major obstacle to the development of smart cities is the shortage of management talent. There are obvious shortcomings in the current talent training mechanism, with few highly qualified talents and the overall quality of the existing talent team is low. In addition, cooperation with universities is not close enough, and the depth and breadth of talent supply and training need to be improved.

Inconsistent information sharing is another key challenge for smart city development. Inconsistent data standards and industry limitations make it difficult to manage, share and use data, and platform information is difficult to update simultaneously. Smart city construction is often led by the government and lacks market research, resulting in construction projects that do not meet people's real needs. In addition, smart city use cases are poorly integrated into the daily lives of citizens, resulting in a poor citizen experience.

Thus, although the development of smart cities in China has achieved some success, profound improvements in infrastructure improvement, planning and design, talent training, and information sharing are still needed to overcome these risks and help smart cities become more mature and efficient. and development in a sustainable direction.

2.2. Smart city budget execution analysis (Beijing Smart City case study)

Managing the City's general budget revenue and expenditure.

In 2023, through the implementation of a series of measures to stabilise expectations and promote development, the city's overall economy will recover for the better, and the city and municipal levels will work together to strengthen the construction of financial resources and stabilise the financial resource base. to increase budget revenue. to increase budget revenue. The city's general budget revenue was 618.11 billion yuan, up 8.2%, exceeding the plan at the beginning of the year by 4.2 percentage points; the adjusted budget was 104.0%, exceeding revenue by 23.82 billion yuan. Taxes accounted for 86.7%, and the quality of budget revenue ranked first in the country for the third consecutive year. Revenue from central government rebates and subsidies, local government bonds, etc. totalled 312.11 billion yuan, and total revenue was 930.22 billion yuan. The city's total government budget expenditure was 797.16 billion yuan, an increase of 6.7% from the adjusted budget; including the central government's expenditure on central government aid and repayment of principal of government bonds of 133.06 billion yuan, the total expenditure was 930.22 billion yuan. The city's overall government budget achieved a balance between revenue and expenditure.

Revenue and expenditure execution of the general public budget of municipalities

The revenue of the general public budget of municipalities in 2023 will be 338.09 billion yuan, accounting for 103.3% of the adjusted budget (surplus revenue of 10.72 billion yuan, all of which will be transferred to the budget stabilisation fund, plus 163.01 billion yuan to the central budget in accordance with the law); government revenue and subsidies, plus 46.92 billion yuan in county issues, local government bond proceeds of 37.37 billion yuan (new bonds of 16.80 billion yuan, refinancing bonds of 20.57 billion yuan), transferred funds of 3.29 billion yuan, budget stabilisation fund of 29.29 billion yuan, and the central government's own

funds of 0.25 billion yuan. 29.29 billion yuan, and transferred local special policy funds of 3.44 billion yuan over the previous year, for a total of 621.41 billion yuan.

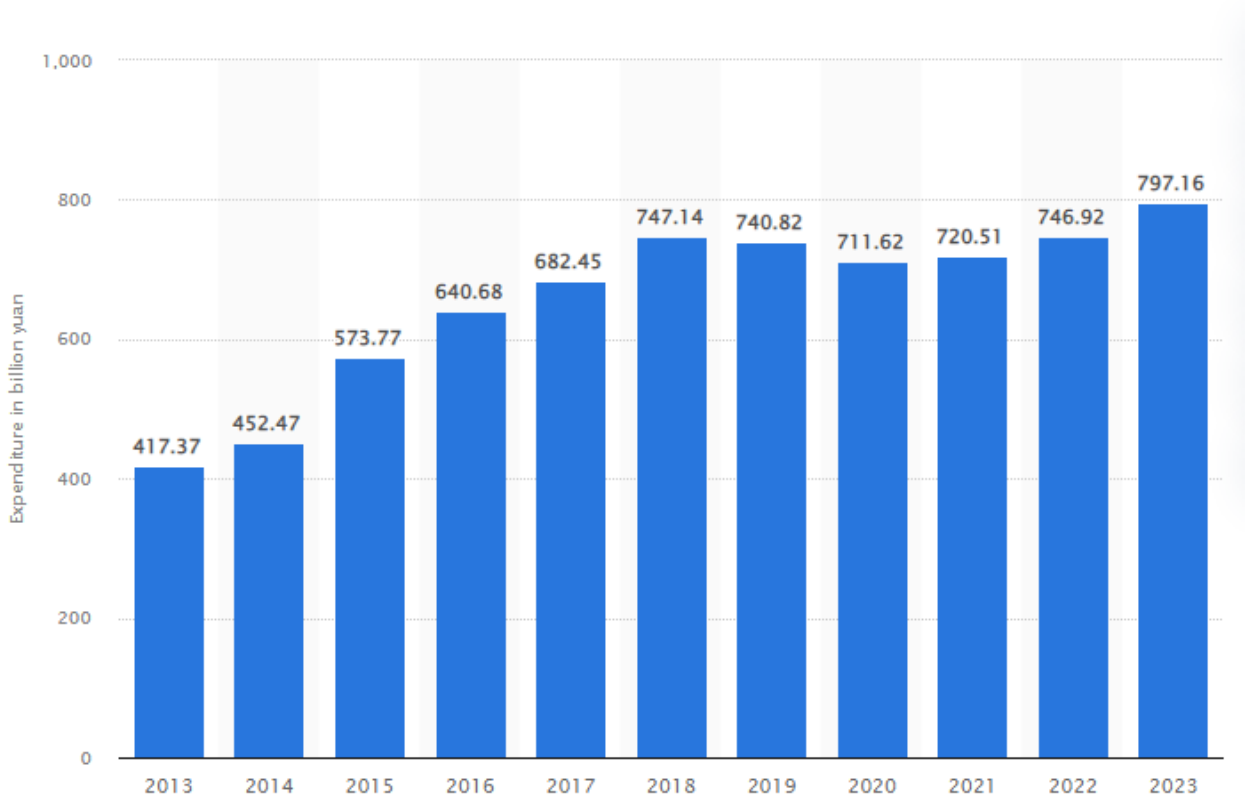

Figure 2.6 – General budget expenditure of the local government in Beijing, China from 2013 to 2023 (in billion yuan)

Source: Qianji Investment Bank's iFinD asset information network [57]

The expenditure of the general public budget of the municipality is 560.60 billion yuan, of which RMB 477.75 billion is provided by local financial resources, accounting for 100.0% of the adjusted budget; RMB 82.85 billion is allocated to central special projects and power transmission co-payments. In addition, RMB 12.07 billion is for central government expenditure, RMB 12.99 billion is for local government bond repayment, RMB 17.15 billion is for local government bond borrowing costs, RMB 40 million is for local government loans from international organisations, and RMB 1.5 billion is for local government loans from international organisations.

In 2023, the city will return and transfer RMB226.18 billion to the district system, accounting for 109.8% of the adjusted budget. This is mainly due to the use of central transfers and capital construction transfers in annual implementation to increase support to each district. . Of which: ¥167.75 billion in district system rebates and general transfer payments, and ¥58.43 billion in special transfer payments. General transfer payments are mainly used to improve the level of basic public services in various districts; to support road rehabilitation and reconstruction projects, repair of water supply facilities, etc. in disaster-stricken areas; to continuously promote action plans such as dredging and urban renewal; to support areas such as Hui Tian and Chengnan districts to speed up the completion of construction. Weak areas to promote and guide ecological reserves to enhance ecological protection and speed up green development, etc. Special transfers will mainly be used to support various districts to promote the popularisation and comprehensive development of pre-school education, to carry out special tasks such as energy saving and emission reduction, environmental improvement and improvement of key areas, and to ensure the implementation of projects in key areas.

In 2023, the municipal government's fixed asset investment will be 68.0 billion yuan, up 20.9%, and 104.6% of the adjusted budget will be implemented. Among them, the total government budget is 43.0 billion yuan, and the government fund budget is 25.00 billion yuan. To the 55.0 billion yuan budget allocated at the beginning of the year, an additional 13.0 billion yuan was added during the year's implementation through measures such as the use of municipal reserve funds and municipal budget stabilisation funds to support various areas in accelerating major activities. projects in areas such as people's livelihood, industrial development, and infrastructure rehabilitation and reconstruction after natural disasters.

Implementation of basic revenue accounts at the municipal level.

In 2023, municipal tax revenue will reach RMB 300.23 billion, an increase of 9.9%. Among them: value-added tax reached 107.13 billion yuan, up 37.8%, mainly due to the implementation of large-scale refunds of withholding tax in 2022 to form a low base, and the gradual recovery of business operations in 2023, driven by the

growth of sales of products and services. Corporate income tax reached 79.41 billion yuan, down 2.4%, mainly due to lower operating profits of enterprises in some industries.

Personal income tax reached 62.59 billion yuan, down 1.6%, mainly due to the increase in the special rate of additional deduction for "one senior and one child" to reduce the burden of family maintenance. Municipal non-tax revenue reached 37.86 billion yuan, down 9.8%, mainly due to the revitalisation of idle assets in 2022 and the accumulation of one-off non-tax revenue to form a high base.

Maintaining the accounts of major local government expenditure.

Education expenditure totalled RM49.58 billion. Of which: RMB 44.22 billion - expenditure organised from local financial resources, including RMB 30.15 billion at the municipal level, accounting for 100.0% of the adjusted budget - RMB 14.07 billion - transfer payments from the city to the districts; mainly used to promote the development of various educational endeavours.

Continue to expand the supply of primary and secondary school places, promote the high-quality and balanced development of compulsory education and the integrated development of urban and rural areas, and ensure the smooth opening of primary and secondary schools in disaster-stricken areas in the autumn; support kindergartens in providing inclusive childcare services for children aged 2-3 years; improve vocational education and training, promote the integration of production and education, and support the construction of high-tech innovation centres; Beijing universities implement the policy of subsidising students from families with financial difficulties, etc.

Expenditure on science and technology totalled 43.50 billion yuan. Of which: 42.05 billion yuan - expenditure arranged by local financial resources, including 41.76 billion yuan at the municipal level, accounting for 99.2% of the adjusted budget - 290 million yuan - transfer payments from the city to the districts; mainly used to accelerate the construction of international science and technology innovation centre. Optimise the direction of scientific research funds and promote the construction of "three cities and one district" at a high level, strengthen the

construction of national strategic scientific and technological capacity to ensure the quality work of national laboratories in Beijing; support new research institutions to conduct organised scientific research, promote the research and development of key core technologies, and support scientific and technological research.

Expenditure on culture, tourism, sports and media totalled RM15.13 billion. Of which: 13.93 billion yuan - Expenditure organised from local financial resources, including 10.89 billion yuan of expenditure at the municipal level, accounting for 100.5% of the adjusted budget - 3.04 billion yuan - Transfer payments from the city to the counties; mainly used to promote the construction of national cultural centres. Deeply promote the protection of the Central Axis as a world heritage site, strengthen the protection, repair and use of key cultural relics in the "one city and three belts"; support the completion and commissioning of Beijing Art Centre, Municipal Library and Grand Centre; Canal Museum and promote the construction of "Book Capital", "Museum City" and "Performing Arts" "City"; improve the network system of public cultural facilities and implement cultural projects for the benefit of the people, support the organisation of sports; activities and activities of the city.

Social security and employment expenditure totalled RM45.64 billion. Of which: 22.37 billion yuan - expenditure organised from local financial resources, including 18.29 billion yuan at the municipal level, accounting for 101.8% of the adjusted budget - 4.08 billion yuan - transfer payments from the city to the districts; mainly used to improve the multi-level social security system. Implement measures to stabilise and expand employment, and help key groups such as college graduates and veterans find jobs and start businesses; strengthen the social security system, steadily increase the level of social security benefits, and improve social insurance systems such as basic pension, basic old-age security, medical care, work injury and unemployment; improve pension policies. The service and security system for military personnel and pension benefits for privileged people should be introduced; social security systems and care systems for people with disabilities should be introduced, accelerated and improved.

Health expenditure totalled RM32.57 billion. Of which: 23.17 billion yuan - expenditure organised through local financial resources, including 19.91 billion yuan at the municipal level, accounting for 98.9% of the adjusted budget - 3.26 billion yuan - transfer payments from the city to the counties; Mainly on the basis of ensuring a high spending base for epidemic prevention in 2022, we will continue to strengthen the construction of the public health system in 2023. Promote the balanced distribution of high-quality medical resources and ensure the smooth opening of new public hospitals; improve the hierarchical diagnosis and treatment system, promote the standardisation of public medical services and expand local rescue capacity; pay close attention to post-disaster problems; disinfect the environment and prevent health and epidemics to ensure that "no one is safe after a major disaster pandemic".

Expenditure on energy conservation and environmental protection totalled RMB18.35 billion. Of which: 15.95 billion yuan - expenditure organised from local financial resources, including 11.92 billion yuan at the municipal level, accounting for 102.3% of the adjusted budget - 4.03 billion yuan - transfer payments from the city to the districts; mainly used to implement the "Green Beijing" strategy. Ensure the overall stable operation of the city's heating system; promote the oil-for-electricity programme for automobiles; support the development of low-carbon technology research and pilot projects to reduce carbon emissions; strengthen the management, control and remediation of soil pollution risks; promote urban and rural water environment management and continuously improve the quality of the ecological environment.

Expenditure by urban and rural local authorities totalled RM35.64 billion. Of which: 23.39 billion yuan - expenditure organised from local financial resources, including 22.21 billion yuan at the municipal level, accounting for 103.1% of the adjusted budget - 1.18 billion yuan - transfer payments from the city to the districts; mainly used to improve the efficiency of urban management. Continue to improve the environmental management of nooks and alleys to create better and more livable streets; further promote the classification of household waste; take numerous

measures to address the problem of property management in old settlements; continue the comprehensive improvement of urban areas; public spaces to improve the quality of life in the city.

Expenditure on agriculture, forestry and water conservancy amounted to 22.20 billion yuan: 19.90 billion yuan was expenditure financed by local financial resources, including 10.07 billion yuan at the municipal level, accounting for 100.2% of the adjusted budget; 9.83 billion yuan was transfer payments from cities to counties; mainly used to fully implement the rural revitalisation strategy. Accelerate the restoration and reconstruction of rural living environment infrastructure after natural disasters; build "seed industry capital" and implement various policies of agricultural subsidies for grain farmers, agricultural machinery procurement, etc.; implement projects to improve the quality and safety of rural housing, and accelerate the reconstruction of dilapidated rural buildings and earthquake-resistant energy-saving reconstruction; provide financial support for the south-north water diversion project and the Yongding River ecological replenishment project.

The cost of transport was 35.37 billion yuan. Of which: 29.41 billion yuan of expenditure organised by local financial resources, including 29.30 billion yuan at the municipal level, accounting for 98.4% of the adjusted budget; 110 million yuan of transfer payments from the city to the districts; mainly used to optimise the layout, structure and operation of transport infrastructure. Implementing the Beijing-Tianjin-Hebei coordinated transport integration development strategy, speeding up the construction of projects such as the Pinggu Line and the Beijing-Tangshan Intercity Railway, strengthening integrated transport management in key areas such as schools, hospitals and scenic spots, and supporting; opening more bus lines to schools; further improvement. The arrangement of highways, buses, bicycle and pedestrian paths creates a green environment for travel.

Expenditure on commercial services and other sectors totalled 1.98 billion yuan. Of this, expenditure organised by local financial resources (municipal level expenditure) amounted to 1.30 billion yuan, accounting for 95.5% of the adjusted

budget. The lower value of the adjusted budget is mainly due to the real demand and the implementation of the supply and procurement policy. stable prices of commodities important to people's lives. Part of the adjusted budget will be transferred to post-disaster rehabilitation and reconstruction and other key tasks. It will mainly be used to play the fundamental role of consumption in stimulating the economy. Ensure the smooth running of the China International Service Fair, help organise a series of activities to promote consumption such as the "Beijing Consumption Season", promote a new round of action plans to transform and improve the business district, and improve the quality of life in service industries such as convenience stores.

Expenditure on housing totalled RM3.21 billion. Of which: RMB 2.30 billion of expenditure organised from local financial resources (municipal level expenditure), accounting for 74.2% of the adjusted budget. The lower than the adjusted budget is mainly due to the adjustment of part of the funds for key tasks such as urban renewal and post-disaster rehabilitation and reconstruction in relevant areas, based on the progress and actual renovation needs of some old localities. It will mainly be used to increase the supply of affordable housing, improve the housing system to facilitate both renting and buying, support the construction of public rental housing, and improve the housing conditions of residents.

Expenditure on disaster prevention and emergency management totalled RMB 30.58 billion. Of which: 2.33 billion yuan - expenditure organised from local financial resources, including 1.86 billion yuan at the municipal level, accounting for 105.4% of the adjusted budget; - 470 million yuan - transfer payments from the city to the counties, mainly for the resettlement of disaster-affected personnel and the construction of disaster-damaged farmhouses; financial guarantees for the purchase, renovation, upgrading and transformation of emergency equipment in the field of firefighting; - 5.37 billion yuan - expenditure to help other regions.

RMB 5.37 billion was spent to help other regions. All expenditure is organised from local financial resources (municipal-level expenditure), accounting for 108.4% of the adjusted budget. The main purpose is to provide comprehensive support and

cooperation in Xinjiang, Tibet and other regions, help the recipient cooperation regions consolidate and expand the results of poverty alleviation, and effectively unify the work of rural revitalisation.

Budget performance of public funds

In 2023, public fund budget revenue was 211.03 billion yuan, accounting for 105.3% of the adjusted budget, exceeding revenue by 10.63 billion yuan plus 158.68 billion yuan carried forward under local special policies and special debt revenue from the previous year, total revenue was 369.71 billion yuan. The expenditure of the public fund budget was 273.71 billion yuan, accounting for 98.7% of the adjusted budget, plus 96.00 billion yuan for the carry-over and use of local special policies in the next year, special debt repayment and other expenditure, total expenditure was 369.71 billion yuan; the municipal budget achieved a balance of revenue and expenditure.

Municipal fund budget revenue in 2023 will be 68.97 billion yuan, accounting for 103.4% of the adjusted budget (2.27 billion yuan overpayment, excluding the transfer to the general state budget in accordance with regulations, all of which will be carried forward to the next year for use in accordance with law); plus central special transfer payments. Revenue of 670 million yuan, use of local special policy carryover of 5.65 billion yuan over the previous year, county revenue of 700 million yuan, special debt revenue of 700 million yuan. 133.89 billion yuan (new bonds of 94.90 billion yuan, refinancing bonds of 38.99 billion yuan), total revenue of 209.88 billion yuan. The local government budget expenditure is 63.61 billion yuan, of which 62.93 billion yuan is distributed from local financial resources, accounting for 100.0% of the adjusted budget; 680 million yuan is distributed by the central government for special transfer payments. Another 1.51 billion yuan was withdrawn from funds, 116.92 billion yuan was spent on special debt re-lending, 21.79 billion yuan was spent on debt repayment, and 6.05 billion yuan was carried forward for policy purposes next year, for a total expenditure of 209.88 billion yuan. The budget of the local government fund strikes a balance between revenue and expenditure.

In the local government fund budget, revenues from transfer of public land use rights and related special debt revenue mechanisms are mainly used for key investment projects such as land reserve development, slum rehabilitation and infrastructure construction. Urban infrastructure support fees and related special debt revenue mechanisms are mainly used for investment projects of the local government. Commercial expenses of lottery sales agencies are mainly used to ensure the smooth operation of charity and sports lottery sales agencies. Charity lottery public welfare funds are mainly used to support the construction of social welfare facilities and the purchase of equipment, social welfare projects, etc. The public welfare funds of the Sports Lottery are mainly used to support the construction of national fitness centres and to promote the development of ice and winter sports. National Film Industry Development Funds are mainly used to promote the development of the film industry.

Performance of the State Capital Operating Budget

In 2023, the revenue of the state capital operating budget was RMB 6.88 billion, accounting for 127.1% of the budget and exceeding the revenue by RMB 1.47 billion, plus the central transfer payment revenue of RMB 80 million and the carryover revenue of RMB 1.36 billion compared with the previous year; the total revenue was RMB 8.32 billion. The government's capital operating budget expenditure was RMB 4.72 billion, accounting for 97.2% of the budget, which was slightly lower than the budget. The main reason was that Fangshan, Haidian and other areas were affected by the extremely heavy rains of 23-.7, and the absorption of some government budgeted projects was postponed. Another 2.11 billion yuan will be transferred to the general government budget and 1.49 billion yuan will be carried forward for use next year, bringing the total expenditure to 8.32 billion yuan. The city's state capital operating budget has achieved a balance between revenue and expenditure.

In 2023, the revenue of the municipal government's capital operating budget will be 5.92 billion yuan, accounting for 118.4% of the budget (overspending of 920 million yuan, all carried forward to the next year in accordance with the law), mainly

due to the improvement of. -In addition to the expected revenue of some state-owned enterprises in 2022 and the increase in dividends from equity projects, 80 million yuan of revenue from central transfer payments and 900 million yuan of revenue carried forward from the previous year, the total revenue is 6.90 billion yuan. Municipal government investment budget expenditure is 4.13 billion yuan, accounting for 100.0% of the budget, which is mainly used to manage the industrial transformation and upgrading of municipal state-owned enterprises, optimising the location of high-precision industries, etc., adding 80 million yuan to the central transfer payment allocation area and contributing to the total state budget: 1.77 billion yuan of funds were transferred, 920 million yuan were carried forward for use in the following year, the municipal government's capital operating budget has achieved a balance between revenue and expenditure.

Budget execution of the social insurance fund

In 2023, the budget revenue of the municipal social insurance fund will be 643.40 billion yuan, accounting for 101.9% of the budget. The budget expenditure of the social insurance fund was 426.41 billion yuan, accounting for 94.0% of the budget. The balance of revenue and expenditure for the year was 216.99 billion yuan, meeting the requirements of balanced revenue and expenditure and a small surplus in the social insurance fund budget.

The above data are initially summarised on the basis of budget implementation and will change after the final local budget reports are compiled. Due to factors such as the actual expenditure of some projects and the use of reserve funds in the respective accounts for certain expenditure items, there are certain differences between the performance data of each account and the budgetary activity. For detailed information and relevant explanations, please refer to the situation of "Beijing 2023 Budget Execution" and "2024 Budget".

Promote financial and fiscal reform and implement the decisions of the Municipal People's Congress in 2023.

In 2023, the financial departments of the Municipality at all levels will strictly implement the "Budget Law", the "Regulations on the Implementation of the Budget

Law" and the "Regulations on the Review and Supervision of the Beijing Municipal Budget", and faithfully implement the resolutions of the first session of the 16th Municipal People's Congress and the review opinions of the Finance and Economic Committee of the Municipal People's Congress, with new ones. Taking the development of the capital as a guideline, we take the development of thematic education as a powerful driving force to work, actively play the role of financial functions, focus on macro-policy control, expand domestic demand, reform and innovation, prevent and eliminate risks, and promote the development of the capital economy with the best standards of high-quality social development.

1. Promote a proactive fiscal policy to enhance the efficiency and effectively promote the viability of market entities.

Market players are the bearers of economic power, and the Ministry of Finance will strive to improve the accuracy and efficiency of fiscal policy to help market players overcome difficulties and develop. Focus on small, medium and micro enterprises and individual industrial and commercial households, continue and optimise some preferential tax policies, and reduce the tax burden on enterprises by more than 85 billion yuan in 2023. Coordinate and effectively use policy funds such as social insurance subsidies, vocational training subsidies and guaranteed enterprise loan subsidies to promote employment and entrepreneurship for key groups. Organise first-loan interest rebates, guarantee fee subsidies and other funds to support state guarantee institutions in "lowering rates and scaling up", so as to promote a steady but sustainable reduction in financing costs for the real economy. Guided by the needs of enterprises, we will improve the mechanism for providing financial resources to enterprises, and direct various districts to coordinate and solve more than 5,000 enterprise development needs. Improve the mechanism of creating urban financial resources, encourage districts to maintain and develop high-quality financial resources, and promote the accelerated implementation of new enterprises and new projects. Actively develop technology financial enterprises, and the construction of international science and technology innovation centres has begun to show results. The financial income of high-tech,

specialised and special enterprises, unicorns and other enterprises increased by 16.2%, 10.5% and 62.5% respectively.

2- Actively use the comprehensive effect of fiscal policies and funds to ensure the implementation of major strategies and important tasks.

We should firmly grasp the main task of quality development, strengthen fiscal support and financing guarantees, and strive to stabilise expectations, expand domestic demand, boost consumption and promote a smooth economic cycle.

Comprehensively implement the national strategy, support the opening of schools and clinics for the "Three Schools and One Hospital" turnkey project in Xiongan New Area, and continuously deepen the joint construction and sharing of public services, ensuring good service for international conferences, such as the Belt and Road International Cooperation Summit and the Global Digital Economy Conference, to support the construction of the "two zones" and promote high-level openness to the outside world. m Increase investment in consumer infrastructure and support the construction of electric vehicle charging stations, smart city infrastructure, cold chain logistics infrastructure, etc.. Continue to implement the vehicle purchase tax reduction policy and the new energy vehicle tax exemption policy to stabilise mass consumption of goods. Implement a series of measures to promote consumption in the holiday economy and the night-time economy to promote the recovery of consumption. Actively pursue the establishment of 111.7 billion yuan worth of government bond funds, complete the three-month forward issuance work, support 148 projects such as the science and technology innovation zone of the pilot free trade zone, the airport zone industrial park and transport infrastructure. and promote efficient investment. and promote efficient investment.

Implementation of a centralised funding policy to support high quality development of specialised and innovative SMEs and to promote business innovation. Public procurement implements "one licence for all" e-business licences and contract shares; the proportion of shares awarded to SMEs reaches 80%, 40 percentage points higher than the national requirement. We have helped SMEs raise 250 million yuan through the "Public Procurement Loan" comprehensive financing

programme; new public investment funds will be set up in areas such as artificial intelligence, medicine and healthcare, robotics and information industry to support the construction of international science and technology innovation centres and the development of high-precision industries.

3. Make every effort to provide disaster rescue and relief, post-disaster rehabilitation and reconstruction, and improve the capital's disaster prevention, mitigation and relief capabilities.

We will make every effort to respond to the extremely heavy rains of "23.7", coordinate the Central Disaster Relief Funds, municipal reserve funds, municipal budget stabilisation funds, departmental budgets, transfer payments and other funds, and make every effort to meet the financial needs for emergency relief, post-disaster rehabilitation and reconstruction, and relief. The affected people should restore production and livelihood as soon as possible and survive the warm winter. Establish a database on the projects of the Disaster Relief and Reconstruction Fund in various fields, conduct joint inspection of "project units-industrial organs-municipal comprehensive departments", and strictly check the content of project implementation and construction standards. Include disaster relief funds in the direct supervision of budget funds, strengthen the full process management and cost effectiveness control of disaster relief funds, and ensure the safe and efficient use of funds.

Actively communicate with relevant national ministries and commissions, actively apply for additional Treasury Bond projects in various fields, and make every effort to secure and effectively use central disaster relief funds, additional Treasury Bond issuance and other relief funds.

4. Continuously improve people's livelihoods and well-being, and continue to protect and improve people's livelihoods.

Adhere to the idea of people-centred development, focus on the "urgent, complex and alarming" problems of the masses, and work conscientiously on people's livelihoods. The share of investment in people's livelihood in the city's budget expenditure is of great importance. has always been more than 80 per cent.

Continue to promote kindergartens to provide inclusive childcare for children aged 2 to 3 years, support more than 6,000 new kindergartens and increase the enrolment rate of inclusive kindergartens to 93%, increase the number of primary and secondary school places by 38,000, continue to consolidate the results; work on "double reduction".

We continued to improve the service system for the elderly, built 6,232 new elderly care beds of various types, opened 232 new rural self-help elderly care centres, and continued to innovate the home care model for the elderly. Strengthen the standardisation of grass-roots health care construction and continue to improve health and medical standards, continue to promote the comprehensive reform of public hospitals, the training of health and medical professionals and the capacity building of medical and health care institutions to improve health care capabilities; . To ensure the safe operation of the city, 183 old villages will be renovated and 822 lifts will be installed in old buildings by 2023; the renovation of supporting facilities such as electricity and gas will be accelerated to promote safe production, as well as the investigation and elimination of fire hazards, so as to improve the safety and resilience management of megacities. Continue to promote the transfer of financial resources to the district level. In 2023, the city's transfers to counties will reach 226.18 billion yuan, an increase of 10.3%, 3.6 percentage points higher than the city's total national budget expenditure. each county to ensure the outcome of the "three guarantees".

5. Further deepen financial management reform and promote safe and efficient fund management.

Through a series of measures such as deepening reform and strengthening management, we will promote the smooth operation of capital finance and overall controlled risks, while effectively supporting high-quality economic development. Establish an evaluation index system for government departments to live a busy life, help departments to consciously control administrative operating costs, and create a lean agency. In 2023, we will reduce total expenditure and non-urgent and non-rigorous expenditure by 2.39 billion yuan, and reduce "three government

expenditure" by 5%. We will deepen the reform of full-fledged budget execution management to achieve full coverage of cities, districts, sub-districts and townships, and set 1,515 new optimised expenditure quota standards for effective budget savings. We will improve the capital budget performance indicator system for State-owned assets, carefully register the ownership of State-owned assets of State-owned institutions and enterprises under their management, and prepare annual asset reports; Comprehensively promote the establishment of an integrated budget management system covering nearly 1,000 municipal-level budget units, all county-level finance departments, and nearly 5,000 county-level budget units, relying on the integrated budget management system to strengthen dynamic monitoring and risk warning; financial operations at the grassroots level. Strengthened the entire management chain of 'borrowing, management and redemption' of government bonds, and led the launch of a pilot project for early redemption of special bonds in the country, saving more than 70% of interest costs and exploring new ways of revitalising existing bond assets and saving interest costs. Improve the "daily monitoring and weekly dispatch" mechanism for special bonds, include special bond projects of major cities in the monitoring scope, and monitor the effective implementation of project specifications. We should resolutely curb new hidden government debt and firmly adhere to the goal of preventing systemic risks. Strictly adhere to the red lines of financial discipline, carry out in-depth special rectification of financial discipline in key areas, strengthen supervision of accounting and evaluation, and carry out special rectification of illegal and unlawful activities such as unlicensed activities of accounting service institutions.

Strengthen the rectification of problems found in audits, and closely integrate rectification work with strengthening governance, improving systems and ensuring accountability. Conscientiously implement relevant decisions on the budget and the final report, consider the opinions of the Municipal People's Congress and its Standing Committee, and actively report to the Municipal People's Congress on the management of state-owned assets, public debt, etc. Actively invited 418 deputies of the National People's Congress; participated in 198 financial performance

evaluation and preliminary evaluation projects; improved the efficiency of fund utilisation; a total of nearly 70,000 accounts and 74.18 million data fragments were transferred to the financial and economic online supervision system of the National People's Congress, ensuring reliable operation; supported the Municipal People's Congress in strengthening financial supervision.

Overall, in 2023, the city's financial departments at all levels will take the lead in overcoming difficulties, strengthening the analysis and evaluation of the economic situation and budgetary revenue and expenditure, enhancing the effectiveness of fiscal macro-control, and improving the integration of fiscal capital. resources and structural adjustment, and achieving a 'tight balance'. The smooth operation of budgetary revenue and expenditure was achieved, effectively ensuring the implementation of large and important activities in the city, and various tasks of financial management reform were successfully completed. At the same time, under the new situations, new tasks and new requirements, there are still some difficulties and problems in financial work. First, the budget revenue growth of some key supporting industries is still under greater pressure. The city's budgeted revenues in 2023 are better than expected. However, the financial industry has been affected by the turmoil in the global financial markets and lower profits in the banking industry. The real estate industry has been hit by the downturn in the housing market and the industry's budgeted revenues continue to decline.

Second, the demand for fiscal expenditure protection is growing rapidly. Expenditures and hard costs in key areas such as the comprehensive implementation of the 14th Five-Year Plan, the construction of international science and technology innovation centres, the quality development of urban sub-centres, post-disaster rehabilitation and reconstruction, and the protection of people's livelihoods continue to increase. Third, the budget management level of some units needs further improvement. Supervision by the National People's Congress, audit and accounting have shown that some districts and departments have not strictly implemented requirements such as comprehensive budget execution management and vigorous reduction of administrative expenses, and there are still shortcomings in information

construction, activation of existing funds and asset management. We will actively take measures to gradually address the above issues.

2.3. Huzhou Case Study: Challenges and Prospects of Smart Cities in China

In recent years, cities around the world have faced many challenges due to the continuous development of urbanisation: parking difficulties, traffic congestion, imbalanced educational resources, contradictions between the supply and demand of healthcare services, and significant environmental pollution.

Urban development is increasingly constrained by a variety of factors, requiring timely adjustments to the industrial structure and improved development methods to adapt to the lives and work of urban residents and to deal with various emergencies. After reaching a certain level of economic and technological development, a new smart city has emerged. The government plays a dominant role in its construction, but enterprises and citizens must also play an active role to improve the efficiency and safety of the city's operation and management, its viability, its overall competitiveness and the happiness index of the whole society.

The purpose of this part of the Master's thesis is to analyse the problems that arise in the process of building a Smart City in Huzhou, and to develop measures and proposals to promote its development.

The concept of a Smart City has been developed on the basis of research into the Digital City, Knowledge City, Ecological City, Learning City and Ubiquitous City. The concept was first proposed by IBM in the United States in 2008 and further developed in the report "Smart City in our country" [9]. In 2012, China defined clear boundaries for applied research of such a city in planning its industrial economic transformation, development and upgrading (2011-2015). In 2014, a new national urbanisation plan (up to 2020) and guidelines for promoting the healthy development of smart cities were published, marking the start of their construction. The process of building a smart city can be divided into four stages.

The first is the collection of comprehensive data about the city, usually supplemented by specialised sensors and other data collection equipment. The second stage is the processing and analysis of urban information, mainly data integration and analysis. The third stage is knowledge acquisition, i.e. the transformation of information into knowledge. The final stage is the formation of so-called urban wisdom, i.e. the application of the knowledge gained in combination with information technologies in all aspects of urban life.

In order to implement China's new urbanisation plan, a new smart city has been created, the construction of which is mentioned in the 13th Five-Year National Informatisation Plan.

The construction of a new smart city is a systemic project with Chinese characteristics, reflecting the reform and innovation of a new governance mechanism to enhance the so-called wisdom of the city [85]. It aims to create a ubiquitous and comprehensive service for people, a transparent and efficient online government, an integrated and innovative information economy, clear urban governance, and a safe and reliable operating system [71]. This will be achieved by planning urban development through an analysis system, continuously introducing innovation through reform, promoting the deep integration of information science and urban modernisation, and creating a new urban development ecology. The essence of building a new smart city is to continuously promote reform and innovation, so the construction process should focus on understanding the meaning of people-centricity and how to achieve practical results.

When analysing the development and challenges of the new smart city in Huzhou, it should be noted that the city is located in the central part of the Yangtze River Delta, 75 km from Hangzhou, 130 km from Shanghai and 220 km from Nanjing. By 2020, the city's gross regional product (GRP) will reach 320.14 billion yuan. Having set out to build a smart city, Huzhou is actively promoting this project, implementing the environmental wisdom of "digital geospatial framework construction" in Changxing County, and exploring the pilot construction of a smart city in Zhili. In 2013, it established a leading group for the development of Huzhou

smart city and a pilot group for the construction of a wireless local area network (WiFi) in Huzhou. In the same year, Zhili City, Wuxing District, was included in the third batch of smart city demonstration pilot projects in Zhejiang Province. So far, six construction tasks set by the provincial government have been successively completed.

At the same time, Huzhou is actively promoting smart applications in key areas such as education, healthcare, city management, transportation, and public and government affairs, and is focusing on building platforms such as a new resident card management system, a family service system in society, a comprehensive GIS application system, a mobile law enforcement system for the city, electronic trading of children's clothing, and interaction with government agencies, to improve the city's intelligent management and service level, and strive to build a new smart city.

However, the main problem in building a new smart city is the lack of overall coordination. The strategic positioning and decision-making goals of the various departments involved in the construction are not aligned, making it difficult to coordinate the city's mechanism and impossible to act effectively.

As a result, the approach to construction is out of step with the times. Individual industries and departments do not fully understand the role of advanced technology in promoting urban development and lack enthusiasm for investing in new technologies, resulting in an industrial base that is unable to integrate effectively with new technologies, limiting further improvement of Huzhou's social and economic benefits. There is a strong emphasis on construction over efficiency, including ignoring the benefits of completed projects.

The process of building a new smart city is facing a shortage of professionals and technology. In terms of the former, construction involves fields such as management science, computer science, geography, architecture, regional economics, urban management, etc. Due to the high degree of systematicity and complexity, the construction of a new smart city requires strong support from a group of interdisciplinary and integrated professionals.

However, there is currently a shortage of relevant human resources in Huzhou, especially in various government departments. In terms of technology, the construction of a new smart city typically involves a variety of new technologies such as cloud computing, big data, the Internet of Things, blockchain and artificial intelligence, as well as the systematic and comprehensive application of space technologies such as GIS, remote sensing, satellite navigation and positioning. For these advanced scientific and technological fields, Huzhou has invested in high-tech research and development.

The development and implementation of high-tech enterprises is fraught with significant challenges. In order to accelerate and effectively develop the new smart city in Huzhou, a series of measures should be taken.

The new smart city in Huzhou will require a series of measures.

Firstly, to clarify the development goals and scientifically justify and facilitate the construction. In the near future, Huzhou will achieve five goals: convenient public services, advanced urban management, livable environment, intelligent infrastructure and long-term network security through the construction of a new smart city, which should scientifically promote the establishment of an information service system covering areas such as medicine and healthcare, social security, employment, environmental protection and public security. The establishment of a management information system covering population management, social integrity and other areas of social management should also be promoted, as well as intelligent environmental monitoring systems, including water, soil and air, and real-time online prevention and control systems, including pollutant emissions and energy and resource consumption.

Second, strengthen higher-level design and ensure intelligent planning. The construction of a new smart city is a process of long-term development and dynamic optimisation, so great attention should be paid to improving the design at the highest level.

Huzhou should start planning from the top, formulate the idea of overall development, interconnection, co-building, integration and sharing, expand overall

deployment, develop new plans and standards for smart city construction, clarify the roles and responsibilities of various departments in the process, and establish a science-based evaluation indicator system.

Third, to clarify the construction concept: define its scope; adhere to the principle of building one system architecture, one network, one platform for public functions, one data collection network, one city operation centre and one set of standards [43], as well as the concept of integrated construction; establish a management platform for common big data services for public resources in Huzhou, form an open system for sharing the city's public resources; overcome information barriers of different types of information.

Fourth, improve management efficiency and promote the introduction of the latest technologies, the development of which is changing every day and covering many areas.

Huzhou should attach great importance to the leading, supporting and key role of professionals and technology in the construction of the new smart city, strengthen the introduction of innovation, investment and technology in a wide range and at multiple levels in combination with actual needs, constantly promote the high-quality, sustainable and sustainable development of Huzhou in the process of building the new smart city, fill the team of professionals with inclusive development. At the same time, it is necessary to actively implement the project of localising professionals, strengthen the training of local innovators, cooperate with colleges and universities, research institutes and educational institutions, conduct joint training and special training in relevant fields, and build the scale and provide reliable support for talented professionals to build a new smart city.

In addition, based on the city's own positioning and reality, it should scientifically formulate an index system for evaluating the construction of Huzhou smart city and evaluation methods based on the completion of the standardised construction scheme of the first ecological civilisation demonstration zone, including environmental protection, resource and energy conservation and utilisation, system and cultural construction. Those in charge should regularly

evaluate the construction and application of the smart city, and continuously improve people's satisfaction.

A more detailed analysis of smart city development issues will be provided by analysing the budget of Wuxing district, Huzhou.

Revenue Budget Execution Status

The county's national budget revenue was 6.656 billion yuan, 100.49% of the expected figure and up 6.52% year on year. Of this, tax revenue was 5.735 billion yuan, up 2.28% year on year, and non-tax revenue was 921 million yuan, up 43.57% year on year;

The implementation status of major revenue accounts is as follows:

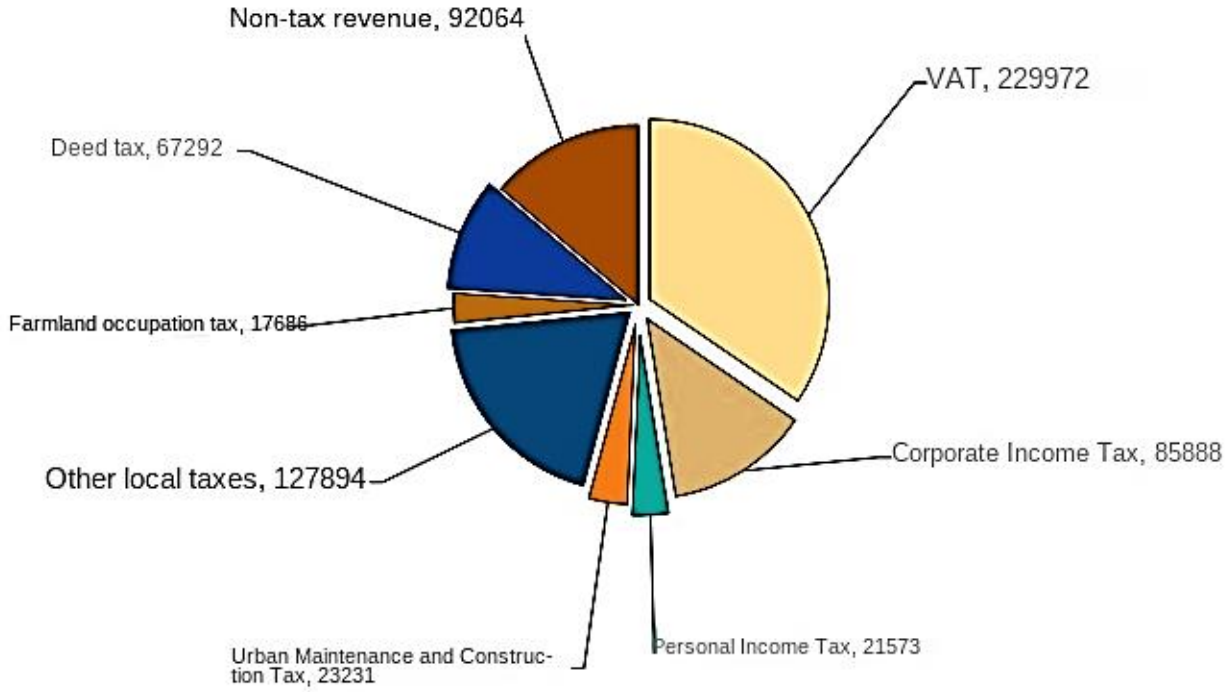

Figure 2.7 – Main revenue subject of the general public budget in 2023 (thoursands of dollars)

Source: Report on the 2023 Budget Implementation and 2024 Budget Draft of Wuxing District, Huzhou City [60]

State of execution of the expenditure budget

The total state budget expenditure for 2023 approved by the second session of the Fifth District People's Congress is 72.48 billion yuan.

The 12th session of the Standing Committee of the Fifth District People's Congress approved an adjusted budget of 7.314 billion yuan (including provincial and municipal transfers), and the actual implementation amounted to 7.020 billion yuan (including 192 million yuan in debt interest and issuance fees), an increase of 1.56% over the previous year, and 95.98% of the adjusted budget was implemented.

Expected revenue

The total revenue of the state budget in 2024 is expected to be 6,989 billion yuan, up 5.00% year on year. This includes tax revenue of 5.923 billion yuan, up 3.27% year-on-year, and non-tax revenue of 1.066 billion yuan, up 15.79% year-on-year. The main revenue accounts are as follows:

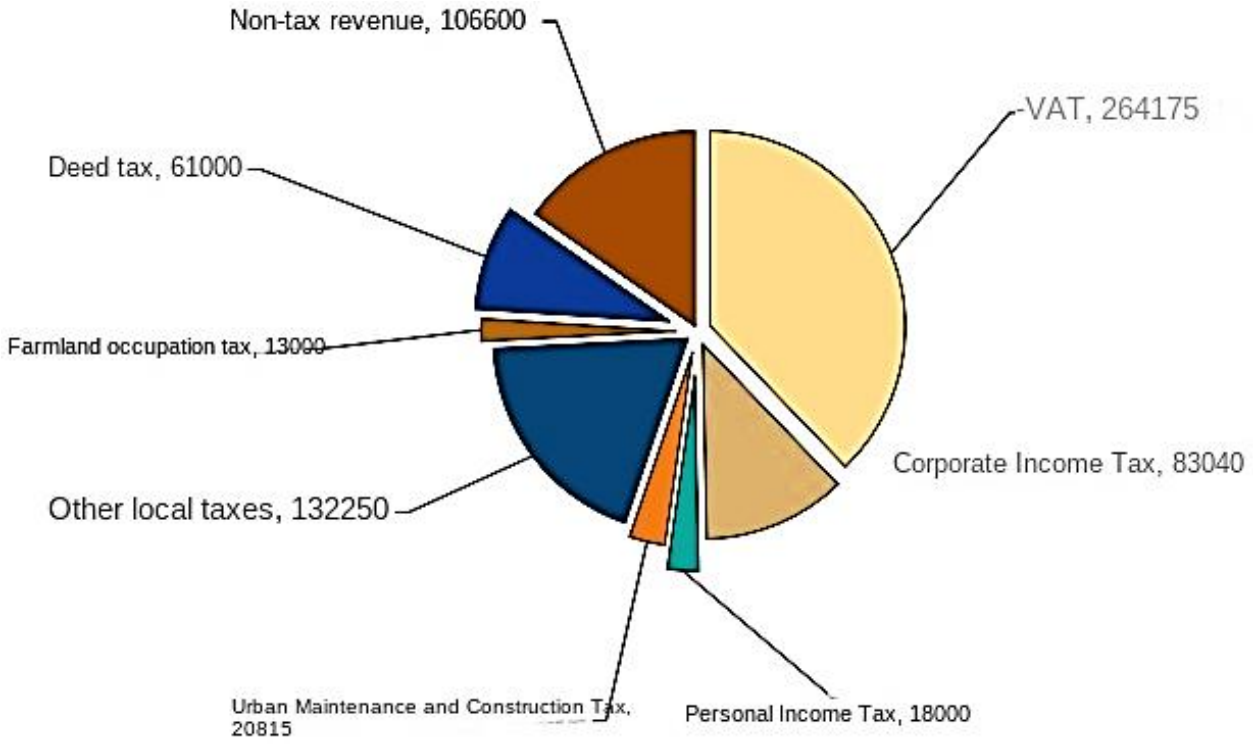

Figure 2.8 – Main revenue subject of the general public budget in 2024 (thoursands of dollars)

Source: Report on the 2023 Budget Implementation and 2024 Budget Draft of Wuxing District, Huzhou City [60]

Main activities of budget work in 2024

Strengthen the management of the revenue and expenditure budget to ensure smooth financial operations. First, pay close attention to the organisation of budget revenue. Deepen the promotion of the ‘1+2+X’ joint financial and tax management mechanism, strengthen the tracking and process management services for enterprises that are key tax sources, strengthen comprehensive services to help enterprises save, strengthen the endogenous strength of enterprises and promote sustainable and stable growth of budget revenue. Strengthen interdepartmental cooperation, accelerate the progress of land construction and take advantage of the situation to improve the efficiency of land construction. Deeply explore the potential of non-tax revenue, revitalise existing budget assets and resources through multiple channels, and strive to ensure smooth fiscal operation. Second, strictly control budget expenditure. Strictly adhere to the schedule, enhance the coordination of financial resources, optimise the budget expenditure structure, concentrate financial resources on major tasks, vigorously reduce general expenditure, non-urgent and non-rigorous expenditure, do not spend expenditure that should not be implemented; be spent or not necessary.

Third, closely monitor the level of treasury guarantees. Continue to improve the dynamic monitoring and management mechanism of treasury funds, analyse and evaluate trends in budget operations, budget execution and management, etc., timely monitor overall changes in treasury fund inflows, outflows and balance, further strengthen revenue and expenditure management. and ensure the smooth operation of budget treasury funds.

Focus on promoting key areas and increasing financial support. First, we will continue to make steady progress and improve quality. Continue to optimise the business environment, actively use the "one-click repayment" policy platform to promote one-click repayment and direct payment of financial benefits to enterprises, and thoroughly implement the "8+4" economic policy system. allocate 2.233 billion yuan to ensure the implementation of the "8+4" policy, and at the same time strengthen the evaluation of existing policies, and based on the evaluation results,

strengthen the package, expand the package, reduce the package, cancel the package and add the package, and strive to improve the accuracy of policies.

Second, make full use of special bonds. Scientifically plan project reserves, strive to obtain new government bond quotas, focus on meeting the financing needs of new projects, and effectively promote efficient investment in our region. Establish and improve the "borrowing and redemption" management system of special local government bonds throughout the life cycle, taking the construction and operation of bond management projects as the basis, researching and formulating appropriate management and operation methods, and improving the debt management system. Third, accelerate the promotion of shared prosperity. Taking the opportunity of the provincial fiscal system to carry out the activities of the "Year of Demonstration and Promotion" for the sake of common prosperity, we will further deepen the pilot work of provincial financial assistance to expand budget projects, improve mass policies, pilot agricultural credit guarantee project. services, and do a good job of expanding the project on the basis of the initial pilot project. We will carry out extensive publicity work to achieve new reform results and ensure that our county is at the forefront of the province.

Further deepen the reform of state-owned enterprises and promote fiscal quality and efficiency. First, fully unleash the leading role of state-owned enterprises. By focusing on key projects in 2024, we will lay a solid foundation for the next stage of work and fully unlock the supporting and leading role of state-owned enterprises in the central work of the region. Second, prevent the financial risks of state-owned enterprises. The working mechanisms of corporate supervision, internal audit and supervisory board will be continuously strengthened, and all types of supervision will be organically linked and synergized to jointly build a comprehensive supervision model for state-owned assets. Improve the construction of internal control and compliance management systems for state-owned enterprises, strengthen risk prevention and control supervision in key areas such as debt, finance and investment, and firmly maintain the bottom line of no major risks. Third, strengthen the unified management of state-owned enterprises.

Strengthen risk prevention and early warning to ensure financial security. First, actively promote the activities of the "Year of Strengthening Financial and Accounting Supervision". Based on the activities of the "Year of Strengthening Financial Supervision" in 2023, in accordance with the relevant requirements of the provincial finance department, we will further strengthen the closed-loop management of "examination + resource allocation + supervision", strengthen supervision of key areas, and effectively improve the quality and efficiency of financial accounting supervision. At the same time, we will continue to carry out audit and rectification work in strict compliance with relevant regulations. Second, debt risk prevention. We will vigorously guard against new hidden debt risks, improve the debt management mechanism, and complete the debt reduction plan in accordance with the debt expansion plan approved by the provincial government. At the same time, we will actively seek policy support for the central government's "debt reduction package plan". Strengthen the debt risk management and control of SOEs in the region, strengthen the management of asset-liability limits, strictly fulfil the basic responsibilities of SOEs, and firmly maintain the risk safety of the bottom line.

Third, prevent financial risks at the grassroots level. Effectively strengthen financial construction at the grassroots level and improve internal control systems to ensure that there are no cases involving financial issues. Considering the security management audits of the township's financial accounts conducted at an early stage, the results of special audits will be continuously published so that the "results" of the audits can better serve the municipal financial work in the future.

CHAPTER 3.
OPPORTUNITIES FOR SMART CITY FUNDING IMPROVEMENT

3.1. Research progress and future prospects of China's smart cities

The smart city is the advanced form and latest expression of the information city.

Since IBM proposed the concept of 'Smart Earth' in 2008, it has triggered a global boom in smart city construction.

Since IBM proposed the concept of 'Smart Earth' in 2008, it has triggered a global boom in smart city construction. Promoted by multinational companies such as IBM and Cisco, 'smart city' is the latest and most advanced form of information city.

Since 2012, the Ministry of Housing and Urban-Rural Development (MOHURD) has been promoting the construction of "smart cities" in China.

Since 2012, the Ministry of Housing and Urban-Rural Development, the Ministry of Science and Technology, the Ministry of Industry and Information Technology and other national ministries and commissions have launched a series of pilot projects for the construction of smart cities.

Since 2012, the Ministry of Housing and Urban-Rural Development, the Ministry of Science and Technology, the Ministry of Industry and Information Technology and other national ministries and commissions have been conducting smart city construction pilot projects.

By the end of 2017, more than 500 cities had explicitly proposed or were building smart cities [35]. Ministry of Housing and Urban-Rural Development

The Ministry of Housing and Urban-Rural Development (MOHURD) has proposed smart cities in terms of security system and infrastructure, smart construction and livability, smart management and service, and smart industry and economy.

The Ministry of Housing and Urban-Rural Development (MOHURD) has proposed a pilot indicator system and a practical content framework for the construction of smart cities (towns and districts) in terms of safety system and infrastructure, smart construction and livability, smart management and services, and smart industry and economy.

(2014-2020), the direction of smart city construction is clearly put forward, and the smart city has become an important means to promote new urbanisation and achieve sustainable development [83].

The smart city has become an important means to promote new urbanisation and achieve sustainable development [83]. The construction of smart cities has important practical significance and value.

With the rapid development of the practice of smart city construction, Chinese scholars in the fields of urban science, geographical science, management science and other various disciplines have conducted more systematic exploration and have conducted more systematic exploration and research, especially along with the Internet of Things, cloud computing, Big Data, artificial intelligence and blockchain and other new generation of information technology breakthrough development, the smart city has become the most important area for scholars to study.

Especially with the breakthrough development of new generation information technology such as the Internet of Things, cloud computing, Big Data, Artificial Intelligence and Blockchain, smart city has become a hot spot for scholars to study. Theoretical exploration, from early attention to smart infrastructure, smart city top-level design framework [88; 32], smart city construction model path, and smart government affairs.

City Construction Model Path, as well as smart government [58], smart tourism [78], smart city management, and smart community [44].

Management, and smart community [44], and gradually shifted to the content of artificial intelligence and blockchain, digital economy, and spatial and temporal information platform.

The research is gradually shifting to the exploration of artificial intelligence and blockchain, digital economy, spatial and temporal information platform [10], and digital twin city.

In practice, local governments have adopted smart cities as an important development strategy and goal.

They focus on the development of the digital economy, the design of smart functional space and the expansion of smart services and applications. This study focuses on the progress of smart city research in China from a multidisciplinary perspective, based on a review of relevant policies.

Based on a review of relevant policies, this study focuses on the progress of smart city research in China from a multidisciplinary perspective, and analyses the key research areas for the future.

This study analyses the progress of smart city research in China from a multidisciplinary perspective and provides an outlook on key research areas in the future.

This study not only helps to promote in-depth research on smart cities, but also helps to expand the construction practice of smart cities.

Smart city is a complex and open giant system with significant systemic

comprehensive characteristics. Since the proposal of smart city in 2008, scholars in China have studied smart city from the perspective of different disciplines such as geographic information, urban science and public management information, urban science, public management and other disciplines to define the connotation of smart city.

Since the proposal of smart city in 2008, scholars in China have defined the connotation of smart city from the perspective of different disciplines such as geographic information, urban science and public management. From the point of view of geographic information science, smart city is considered to be a systematic and integrated system through ubiquitous sensor network.

The ubiquitous sensor network connects the digital city with the real city, stores, calculates, analyses and decides on the massive data.

Data storage, computation, analysis and decision-making to the cloud computing platform, and according to the results of analysis and decision-making, various facilities will be the results of analysis and decision-making, and automated control of various facilities according to the results of analysis and decision-making [42].

From the perspective of urban science

Science perspective, it is believed that smart city construction is an important impetus to promote the development of new urbanisation [54].

Impetus [11], in addition to technological support, the impact of information technology on urban government, enterprises and residents' activities and their space should be fully considered [89].

Government, enterprises and residents' activities and their space [89]. And smart city is understood as the use of a new generation of information technology to solve the problem of urban and rural development.

And smart city is understood as the use of a new generation of information technology to solve the problems of urban and rural development, to achieve economic, social and environmental economic, social and environmental coordination and efficient development [18]. From a public management perspective

From the perspective of public management, smart city is considered as an integrated design and systematic analysis of technology, people and environment to achieve the common development of multiple subjects [95].

Systematic analysis to achieve smart governance with the participation of multiple subjects [95]. Addressing urban disaster risk, it is possible to achieve the goal of "smart city" by establishing an urban emergency support system with accurate assessment and rapid response.

By establishing an urban emergency support system with accurate assessment and rapid response, it is possible to move from 'reacting after the event' to 'preventing before the event' [93- 19].

From 'reacting after the event' to 'preventing before the event' [93- 19]. From a systems engineering perspective, modern cities are composed of 'cyber-physical-social' and so on.

From a systems engineering perspective, it is believed that the modern city is formed by the coupling of three systems such as 'cyber-physical-social', and the 'wisdom' of the modern city is expressed as 'wisdom'.

The 'intelligence' of the modern city is expressed in three forms of intelligence such as 'physiological intelligence', 'social intelligence' and 'artificial intelligence' in a broad sense.

The 'intelligence' of modern cities is the 'total harmonious intelligence' formed by the synthesis of 'physiological intelligence', 'social intelligence' and 'artificial intelligence' in a broad sense, and its evolution process corresponds to the development of smart cities.

The evolution process corresponds to the development process of the smart city [99].

Research on the development stages of smart cities

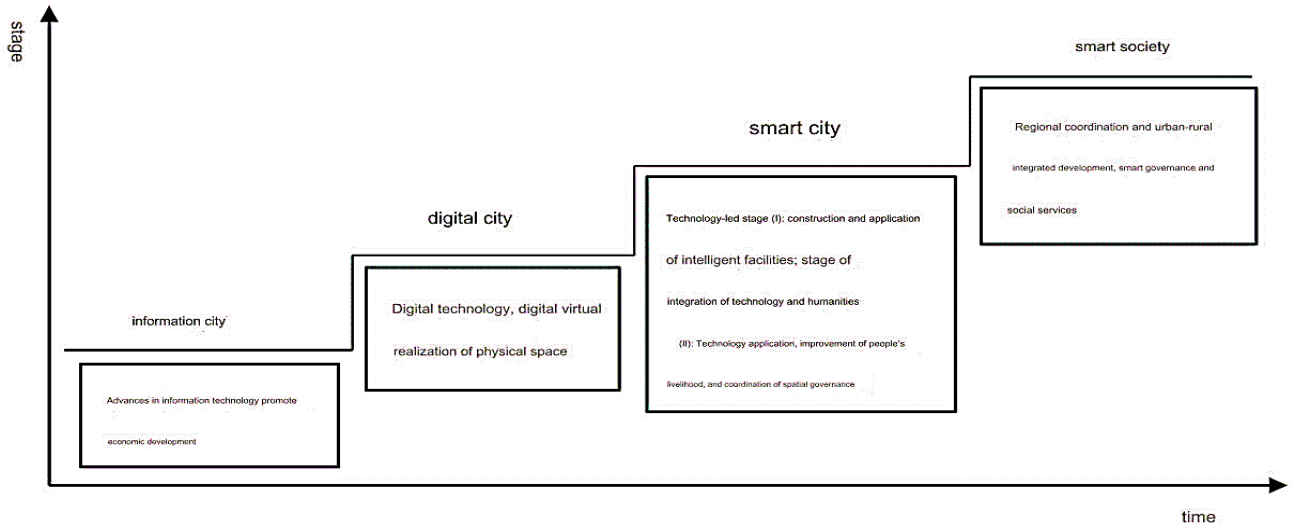

Figure 3.1 – The Development Stages of Smart Cities

Source: Author's compilation

In recent years, scholars have studied the development stages of smart cities, mainly focusing on the position of smart cities in the process of urbanisation and urban-rural integration to the position of smart cities in the process of urbanisation and urban-rural integration, and the stages of smart cities themselves (Figure 3.1). Smart cities are the advanced stage of information-based urban development.

The smart city is an advanced stage in the development of information-based cities. Traditional cities develop towards intelligence, ecology and sustainability.

The traditional city continues to develop towards intelligence, ecology and sustainability, and eventually moves towards the stage of smart city development. The development of modern cities can be divided into information city, ecological city and sustainable city.

The development of modern cities can be divided into three stages: information city, digital city and smart city segments, with the landmark events of each phase occurring in the United States [42]. Information city is a city that makes full use of information technology An information city is a city that makes full use of information technology, develops and utilises information resources, promotes information exchange, and facilitates the exchange of information.

The information city is a city that makes full use of information technology, develops and utilises information resources, promotes information exchange and knowledge sharing, and then promotes economic and social transformation and development [139]. The digital city is based on the information city using remote sensing.

The digital city is based on the information city, using remote sensing, global positioning system, geographic information system, aerial photogrammetry, urban planning and urban design.

System, aerial photogrammetry, urban simulation, virtual display and other technologies to digitally present the physical city in virtual space. City in virtual space for digital presentation [146]. Entering the smart city development stage. Entering the stage of smart city development, through the organic fusion of digital city and physical city, the formation of virtual and real space [42], and with the help

of cloud computing and artificial intelligence technology to provide a variety of intelligent services.

Services with the help of cloud computing and artificial intelligence technology [117].

Under the joint promotion of 'people' and 'technology' [142], the city in the mobile information age has become a new smart city.

Under the joint promotion of 'people and technology' [142], the city in the mobile information age has become a new smart city integrating technology, economy, society and space [134].

a new smart city integrating technology, economy, society and space [134]. The future stage of smart society development. The future stage of smart society development. Smart society is to realise a wider range of spatial wisdom, especially to wisdom, especially to promote regional integration and synergy, and urban-rural integration and development, in order to realise the to realise the higher vision of smart society [128]. At the same time, smart governance, which dynamically combines intelligent technology and social pluralism, is also the key to the development of a smart society.

At the same time, smart governance, which is a dynamic combination of smart technology and social pluralistic governance, is also an important manifestation of smart society [114].

Research on the drivers of smart cities

The development of smart cities is influenced by many factors that are interrelated and mutually reinforcing.

The factors are interrelated and mutually reinforcing, and together they promote the development and innovation of smart cities. Research on the influencing factors of smart cities mainly focuses on the following aspects: Technical factors.

Research on the influencing factors of smart cities mainly focuses on the following aspects: technical factors. Digital city, Internet of Things and cloud computing are the three major technologies that form the basis of smart city development [115].

The application of big data and artificial intelligence technologies provides scientific decision-making for public resource allocation and urban governance [115; 101].

The application of big data and artificial intelligence technologies provides scientific decision-making support for public resource allocation and urban governance, helping to optimise smart city functions [88; 32].

The application of big data and artificial intelligence technologies provides support for scientific decision-making in public resource allocation and urban governance, and helps to optimise the functions of smart cities [88, 107, 119]. Geographic Information Systems (GIS), Building Information Modelling (BIM) and City Information Modelling (CIM) are key elements in the development of smart cities.

GIS, Building Information Modelling (BIM) and City Information Modelling (CIM) have optimised the model representation of the physical city in the Smart City platform [96].

In recent years, the birth of blockchain technology has effectively facilitated the sharing, use and security of smart city information. In recent years, the birth of blockchain technology has effectively facilitated the sharing, utilisation and security of smart city information [147].

At present, the most important of the technological factors. Internet of Things (IoT) technology, which can be regarded as the core of the smart city, and some scholars even believe that the smart city is the specific IoT technology. Some scholars even believe that the smart city is a specific application of the IoT.

Some scholars even believe that smart cities are specific applications of the Internet of Things (IoT). New IoT applications are driving smart city initiatives around the world.

The IoT is at the heart of smart cities. It provides the ability to remotely monitor, manage and control devices, as well as create new applications. Massive streams of real-time data to generate new insights and actionable information [101].

Capital factor. Capital is the economic basis for the construction and operation of smart cities. In the initial stage of smart city construction, government investment is the main source of capital.

With the deepening of smart city construction, the PPP model of government and social capital cooperation has become the optimal way to promote the construction of smart cities in China [101].

With the deepening of smart city construction, the PPP model of government-social capital cooperation has become the optimal way to promote the construction of smart cities in China [120]. The capital element promotes scientific and technological innovation by optimising the economic operating environment to promote smart city construction [109,120], optimising the economic operating environment to promote the construction of smart cities [127; 129] .

Infrastructure is the underlying architecture in smart city construction, and information infrastructure is more related to the goal of smart city construction and plays an important role in the decision-making of smart city construction [91, 124].

Information infrastructure is more related to the goal of smart city construction and plays an important role in the decision-making of smart city construction [91, 124]. Industrial factors. The development of smart industry starts with the creation of new industries.

The development of smart industry promotes the optimisation and upgrading of industrial structure and economic development by creating new industries and promoting the integration of information technology and traditional industries [91, 124].

It optimises and upgrades the industrial structure and makes economic development smarter, healthier and more efficient [113].

Political factors. From the national to the local level, many policy documents on smart city development have been issued [138]. Policy documents [138; 92], and by piloting smart city policies, cities can interact and learn from each other.

Can interact and learn from each other's policies [131]. The gradual establishment and improvement of the smart city policy system.

The gradual establishment and improvement of the smart city policy system is an important guarantee for the healthy and orderly promotion of smart cities [90].

The gradual establishment and improvement of the smart city policy system is an important guarantee for the healthy and orderly promotion of smart cities [90].

Research on the logical framework of smart cities.

The logical framework of a smart city plays a very important role in guiding the planning, construction and management of a smart city. The logical framework of a smart city plays a very important role in guiding the planning, construction and management of a smart city. In recent years, scholars have explored the logical framework of smart cities from different perspectives.

In recent years, scholars have explored the logical framework of smart cities from different perspectives. The technical support perspective. Wu Xiibo constructed the Wu Xiibo constructed the "perception layer, network layer and application layer" [106]; Li Deren and Song Gang added a service layer between the network layer and the application layer, and proposed a three-layer framework, including a service layer between the network layer and the application layer.

Li Deren and Song Gang added a service layer between the network layer and the application layer, and proposed a framework including a perception layer, network layer, service layer and application layer [115; 102]; with the development of cloud computing technology, the service layer structure is further developed.

With the development of cloud computing technology, the service layer structure is further refined, and the service layer can be divided into infrastructure layer, data layer and platform layer.

With the development of cloud computing technology, the service layer structure is further refined, and the service layer can be divided into three layers: infrastructure layer, data layer, and platform layer [118]. Social management perspective. Xu Qingrui. Xu Qingrui fully considered and analysed the social aspects of the smart city, and proposed the "three layers and four pillars" of the smart city.

The "three layers and four pillars" framework model, where the "three layers" are the mass foundation, the innovation system, and the innovation system. The 'four

pillars' are information/digital technology, science, technology and innovation systems, policies and institutions, and intelligent social services. The 'four pillars' are information/digital technology, science, technology and innovation systems, policies and institutions, and intelligent social services [135].

Economic operating perspective. Smart City

City framework is divided into two parts: input elements and output outcomes, highly skilled human resources, information technology infrastructure and capital are important input elements, and smart resources, information technology infrastructure and capital are important output elements.

Highly skilled human resources, information technology infrastructure and capital are important input elements, and smart city governance, society and economy, and smart city operation are important output elements.

The smart city governance, smart society and economy, smart life of residents and smart humanities are the output results. The smart city governance, smart social economy, smart residents' life and smart humanities are the output results, which form the input-output framework of smart city construction [105].

Output framework [105]. Integrated planning perspective. Zhen Feng proposed an integrated planning perspective from the technical, social, spatial and security dimensions.

Comprehensive dimensions of technology, society, space and security, and proposed a top-level design framework for smart cities [133]. Lu Xiaomin considering the needs of the "city subject", she designed a top-level design framework consisting of the basic elements of the city, operation and management, public services, technical support, and the development of a smart city.

Management, public services, technical support, legal protection, evaluation and other six systems.

The overall framework of smart city top-level design is designed by six systems, including basic elements of the city, operation and management, public services, technical support, legal protection and evaluation [50].

Industrial applications of smart cities

Researchers define industrial applications of smart cities from different perspectives:

Application content perspective. Smart cities can provide a variety of applications for human life, economic and social development, cultural enjoyment, environmental protection and administration [42; 116-149] development, cultural enjoyment, environmental protection and administrative management [42; 116-149].

With the deepening of smart city research, the application industries are further divided into smart government, smart transportation, smart education, smart business, smart education and smart management, services, smart transportation, smart education, smart healthcare, smart home, and smart community [42; 116-149].

With the deepening of smart city research, the application areas are further divided into smart government, smart transportation, smart education, smart healthcare, smart home and smart community [42; 111 - 123]. Application hierarchy perspective. Smart city applications can be into several levels, namely basic business, administrative business, smart service and smart city operation and management.

Smart city operation and management, with low-level applications supporting high-level applications, and high-level applications control the operation of low-level applications [97].

Service process perspective. In the smart application and practice of smart city system, city managers tend to pay more attention to the service process of its application.

Service process. Taking smart city management as an example, it can be divided into five major applications according to the service process: perception, analysis, service, command and control [132].

Taking smart city management as an example, it can be divided into five major applications according to the service process: perception, analysis, service, command, and monitoring [132]. System composite perspective. The business

framework of smart city consists of five business units, business interactions, IT capabilities, business goals, and service objects.

The business framework of smart city consists of five modules, namely business unit, business interaction, IT capability, business target and service object, and each module is divided according to its content.

Each module is divided according to its content, and each module is connected and interacts with each other horizontally, vertically and laterally, forming a multi-dimensional system and interactions between the modules horizontally, vertically and laterally, presenting a multi-dimensional perspective of the three-dimensional urban application and interactions between the modules horizontally, vertically and laterally, presenting a three-dimensional urban application structure with a multi-dimensional perspective [123].

Research on development strategies and countermeasures for smart cities

The smart city development strategy is a long-term, global and fundamental plan for the development of smart cities.

The development strategy is a long-term, global and fundamental plan for the development of the smart city, and the development countermeasures are the specific and immediate means and measures to realise the development strategy of the smart city.

The development countermeasures are the specific and immediate means and measures to realise the smart city development strategy. In general, scholars mainly focus on.

In general, scholars mainly focus on the following aspects of strategy and countermeasure research strategy and countermeasures of top-level smart city development.

The strategy and countermeasures of the top-level design of smart cities. The construction of smart cities should be based on the overall situation and public interests and needs. to formulate a scientific and rational top-level design scheme [133].

Based on the mature system structure, we should follow the structure of hardware, software, resource construction, talent cultivation, etc. [122].

At the same time, we adhere to the requirements and values of local adaptation and people-oriented. At the same time, we adhere to the requirements and values of local adaptation and people-oriented, to build a smart city with Chinese characteristics, and to realise the "economic-social-ecological" comprehensive sustainable development and ecological' comprehensive sustainable development to satisfy the residents' sense of security and happiness [135].

The challenge of global mobility can be met by designing local spatial places [137]. The challenge of global mobility can be met by shaping localised spatial places [137]. Based on their own scale and comparative advantages, cities need to propose smart city goals and topology in line with their actual development.

Smart city goals and top-level design frameworks should be based on the scale and comparative advantages of each city [143].

Strategy and countermeasures. In the construction of the smart city, it is necessary to deal with the relationship between the "invisible hand" of the market and the "visible hand" of the government.

In the construction of the smart city, it is necessary to address the relationship between the "invisible hand" of the market and the "visible hand" of the government, and establish a dual-wheel drive mechanism in which the market and the government work together [138].

Government to establish a two-wheel drive mechanism [138]. Encourage broad participation of social actors in co-construction and encourage private institutions to participate in co-construction.

Encourage social actors to participate in co-construction and encourage private organisations to assist the government in managing public affairs and share operational risks [100].

Encourage social actors to participate in co-construction, and encourage civil institutions to assist the government in handling public affairs and share the

operational risks [100]. Smart city innovation promotion strategy and countermeasures.

The construction of smart cities should address the relationship between technological innovation and institutional innovation, and promote the effective docking of industrial technology and financial capital.

Technology and financial capital, and give full play to the important role of private enterprises and private capital in the construction of smart cities [100] and private capital in the construction of smart cities [138]. At the same time, encourage the public to participate in the design and experience of online government services, and give full play to the design and experience of online government services, and give full play to the role of Internet companies in promoting open innovation [148].

Information sharing strategies and countermeasures for smart cities. China's cities often lack interconnectivity between China's cities often lack interconnectivity and information sharing between departments, and there are "information islands" and information fragmentation.

There are problems such as 'information islands', information fragmentation and formalisation of information construction, which cause a large amount of resources to be wasted [94].

Building a public open data platform is an important step for smart cities. The establishment of a public open data platform is an indispensable element in the construction of smart cities.

The establishment of a public open data platform is an indispensable element in the construction of smart cities, and it is also an important foundation for the government's open data services.

The construction of the platform needs to be government-led, with multi-party participation and adherence to the principle of social interaction. Sharing principle [100], especially the need to strengthen cross-regional, cross-sectoral and cross-level data

The construction of open data platform must be government-led, multi-party participation and adherence to the principle of social-oriented interaction sharing

principle [100]. Smart city security strategies and countermeasures. At present smart city construction faces market, technical compatibility, information security and other risks.

Risks. In order to promote smart city construction from a high starting point and in a comprehensive manner, it is necessary to systematically assess the potential risks.

It is necessary to systematically assess the potential risks faced by smart cities, improve standards and regulations, and strengthen network security capacity building, so as to provide effective security for smart cities.

It is necessary to systematically assess the potential risks facing smart cities, improve standards and regulations, and strengthen network security capacity building to provide effective security for smart cities [138; 92].

Security system for the efficient and safe operation of smart cities [138; 148; 140].

Although there have been a lot of studies on the connotation, logical framework, development strategy and countermeasures of smart cities, there are some problems in the current smart city research.

Although there have been a lot of studies on the connotation, logical framework, development strategy and countermeasures of smart cities, there are some problems in the current research on smart cities.

The lack of interdisciplinary integration, weak systemic nature, insufficient integration with the development needs of the times and other weak directions need to be strengthened.

However, the current smart city research lacks interdisciplinary integration, weak systemic nature, insufficient integration with the development needs of the times and other weak directions need to be strengthened.

First, there is a lack of interdisciplinary smart city research. Scholars from different disciplines

Scholars from different disciplines have conducted theoretical research and practical exploration of smart cities based on their own disciplinary perspectives.

However, these results have obvious disciplinary 'traces' and are not systematic and comprehensive.

However, these results have obvious disciplinary 'marks' and are not systematic and comprehensive [89; 108]. Taking the research on smart city frameworks as an example, there are has focused either on the construction of technical frameworks or on specific smart applications, but not on the construction of smart city frameworks from a multidisciplinary perspective.

Research on smart city frameworks, for example, focuses on the construction of technical frameworks or specific smart applications, but less on the construction of integrated research frameworks that integrate technology, activities, space and management from a multidisciplinary perspective.

Research frameworks that integrate technology, activities, space and management from a multidisciplinary perspective are relatively rare.

Secondly, the research on smart city system is neglected. The research scope of smart city mainly focuses on the inner city, and the research on smart city from the regional perspective is less, and it is based on the research of smart city cluster.

The research scope of smart city mainly focuses on intra-city, and there are fewer smart city studies from the regional perspective, which are based on smart city clusters, and have not yet involved in systematic and standardised smart city system research [125]. There is a wide range of links and two-way interaction between the elements of the city and those of the region in which it is located.

The city cannot realise smartness independently from the region. Therefore, it is necessary to explore the construction of a new theory of smart city system to realise the wisdom of the regional system and promote the sustainable development of the region and promote the sustainable development of the region.

Third, there is a lack of systematic research into the factors that influence smart cities. The findings are as follows more research on factors such as technology, capital, population, infrastructure and policy and less research on factors such as social culture, environment, openness and cooperation; from a single factor

perspective, the impact of each independent factor on the development of smart cities is analysed.

From the perspective of a single factor, the impact of each independent factor on the development of smart cities is analysed. The impact of each independent factor on the development of smart cities is analysed from a single factor perspective, while the synergistic effect of each factor on the development of smart cities is rarely analysed from a systematic perspective [126].

Research on factors such as smart city development is scarce. At the same time, most scholars analyse the influence of smart cities from a static perspective, ignoring the influencing factors and their structures.

At the same time, most researchers analyse the influence of smart cities from a static perspective, ignoring the factors and their structures.

Fourth, the study of development paths in the new era has been neglected. The 19th National Congress pointed out that socialism with Chinese characteristics has entered a new era.

Intelligent technology plays an important role in improving the match between people's demand for a better life and supply, and promoting the coordinated development of urban and rural areas.

Intelligent technology plays an important supporting role in improving the match between people's demand for a better life and supply, and promoting the coordinated development of urban, rural and regional areas.

In particular, the new development concept of innovation, coordination, green, openness and sharing has been put forward, which requires the construction of smart cities.

In particular, the new development concept of innovation, coordination, greenness, openness and sharing requires the construction of smart cities to respond positively. However, research in this area has just started and there are not many relevant research results.

Future-oriented smart city research and innovation should focus on core functions, system structure, system organisation, element mechanism, path and strategy.

The future-oriented smart city research and innovation should focus on the core contents such as connotation, function, system structure, system organisation, element mechanism, path and strategy.

The research process should focus on the synergistic development of urban technology, social culture, economic development, spatial function, resource environment and various facilities.

The research process should focus on the synergistic development of urban technology, social culture, economic development, spatial function, resource environment and various facilities.

In the research process, it should focus on the synergistic development of urban technology, social culture, economic development, spatial function, resource environment and various facilities, emphasising the integration of technology, methodology, virtual and real space, and the integration of technology, methodology, virtual and real space, and the integration of technology, methodology, spatial function, resource environment and various facilities.

It will focus on the integration of technology, methodology, virtual and real space, and policy in the study of smart cities, conduct interdisciplinary.

Research on the connotation, standard and index system of intelligent city across disciplines, and research on intelligent city system and network structure. Research on smart city system and network structure.

Through the method of multi-source data fusion, we will conduct research on smart city simulation, digital twin city and smart city system synergy.

We will conduct research on smart city simulation, digital twin city and smart city system synergy, and research on the influencing factors and dynamic mechanism of smart city from the perspectives of comprehensiveness, system and dynamics.

We will conduct research on the influencing factors and driving mechanism of smart cities, and explore the coordinated, innovative, green and sustainable development of smart cities and explore the coordinated, innovative, green, open and shared development path of smart cities in accordance with China's situation (Figure 3.2).

Strengthening interdisciplinary research on smart cities

Interdisciplinary research is not only conducive to the stimulation of new points of innovation and growth, but also breakthroughs in science and technology, and it is an important trend in modern scientific research.

It is an important trend in modern scientific research. The so-called interdisciplinary research is to break the narrow disciplinary bias, break the boundaries between disciplines and cross different disciplines.

So-called interdisciplinary research is to break the narrow disciplinary bias, break the boundaries between disciplines, and transcend the 'paradigms' of different disciplines (theories, methods, models, paradigms, and research traditions, etc., which are interrelated and interact with each other).

National standards for cities are mainly led by academics and companies in the ICT field.

They generally favour technical principles and requirements for building smart cities. In the follow-up standards research, we should pay more attention to the specification requirements in the areas of smart city system, public security, public privacy and so on.

In the follow-up standard research, more attention should be paid to the normative requirements in the fields of smart city system, public security, public privacy and so on, and more scholars in the field of social humanities should be organised to participate.

Strengthen interdisciplinary research on the evaluation index system of smart cities.

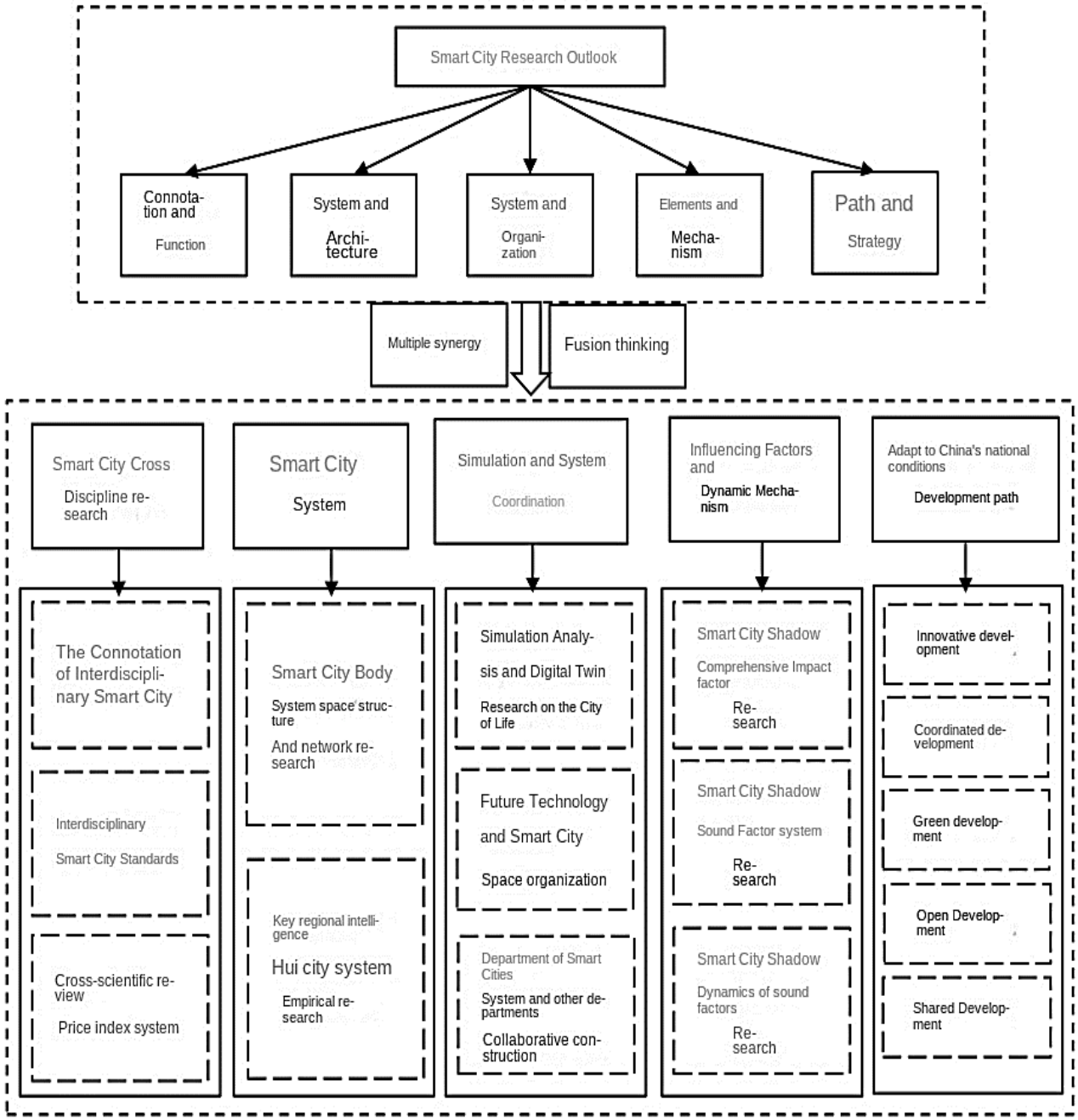

Figure 3.2 – The Future Research Priorities and Content of Smart Cities

Source: Author's compilation

Strengthen the research on interdisciplinary smart city evaluation index system. Indicators from different disciplinary perspectives, expand the evaluation

scope of indicators, balance the proportion of different indicators, analyse and summarise a more scientific and comprehensive evaluation index system.

Analyse and summarise a more scientific, comprehensive and systematic smart city comprehensive evaluation index system. At the same time, differentiated smart city evaluation indexes will be formulated for large, medium and small cities, developed regions and underdeveloped regions.

At the same time, a differentiated smart city evaluation index system for large, medium and small cities, developed regions and underdeveloped regions will be formulated.

With the promotion of the new generation of information and communication technology, the information and communication network is developing at a high speed, and the flow of information between cities has further narrowed the distance between cities.

With the promotion of the new generation of information and communication technology, the information and communication network is developing at a rapid pace, and the flow of information between cities has further narrowed the distance between cities.

The significance and status of cyberspace has been further highlighted, and its integration with physical space has had a subversive impact on the spatial structure and network system of the traditional urban system.

The significance and status of cyberspace has been further highlighted, and its integration with physical space has had a subversive impact on the spatial structure and network system of the traditional city system, forming a smart city system. With the establishment of the smart city information platform, smart city applications are gradually enriched.

With the establishment of the smart city information platform, smart city applications are gradually enriched and can be rapidly exported and shared based on the information network.

Will they break the functional structure and scale structure of traditional cities? Whether they will break the functional structure and scale structure of

traditional cities will become an important issue in the theoretical study of smart city system.

City system empirical research. The regions with faster development of smart cities are mainly concentrated in the eastern coastal regions, especially the Yangtze River Delta, Pearl River Delta and Beijing-Tianjin-Hebei regions.

Coastal regions, especially the Yangtze River Delta, Pearl River Delta and Beijing-Tianjin-Hebei regions

The regions with faster smart city development are mainly concentrated in the eastern coastal areas, especially the Yangtze River Delta, Pearl River Delta and Beijing-Tianjin-Hebei regions, as well as the key regions in central and western China. These regions have a better economic and social foundation and a higher degree of urbanisation, making it easier for them to develop smart cities.

They have a better economic and social foundation and a higher degree of urbanisation, making it easier for them to form a smart city system with a central city as the core.

These regions have a better economic and social base and a higher degree of urbanisation. Therefore, it is important to conduct empirical research on smart city systems in these key regions while strengthening the smart city system.

At the same time, it is necessary to strengthen pilot policy research on the smart city system to provide good experience for the development of the smart city system.

At the same time, it is necessary to strengthen the research on the pilot policy of the smart city system, so as to provide good experience for the development of the smart city system.

Strengthening smart city simulation and system cooperation research

Based on the progress and development of future technologies such as communication technology, unmanned driving, artificial intelligence, etc., strengthen smart city simulation modelling under the application scenarios of future technologies.

Based on the progress and development of future technologies, strengthen research on smart city simulation modelling and element system synergy construction under the application scenarios of future technologies.

Research on simulation and elemental system synergy construction Promote smart city simulation and analysis and digital twin city research.

Promote smart city simulation and analysis and digital twin city research, based on the urban big data platform and "smart brain" construction, integration of Brain' construction, integrating BIM, CIM and other technologies, and large-scale integration of data and information in the three-dimensional space of the city.

Integration of data information, dynamic display, spatial simulation modelling and analysis of the three-dimensional space of the city, and explore the relationship with the physical space of the entity.

Analysis, and explore the construction and operation of the digital twin city synchronously with the physical space of the entity [107].

City [107], and establish a human-computer interactive intelligent city planning, construction and operation and management of the whole life cycle intelligent decision-making system. Intelligent decision-making system for the whole life cycle of smart city planning, construction and operation management;

Conduct research on the functional spatial organisation of the smart city under future technology application scenarios. Under the future technology application scenario, research on the functional spatial organisation of smart cities will be carried out to explore.

Within the framework of the future development of the smart society, the changes in the location, agglomeration and diffusion of the smart city will be investigated.

In the context of the future development of the smart society, the changes in the location, agglomeration and diffusion of various social and economic activities in the city will be studied, as well as the evolution of the relationship between the functional spatial organisation of the city and the matching of supply and demand for facilities [103].

For example, in the future scenario where driverless technology is widely used, how to adjust the urban transport system, transport facilities and resource allocation mode?

How can the urban transport system, transport facilities and resource allocation be adapted? How to plan the urban road network and parking facilities to adapt to the development of driverless technology?

How to plan the urban road network and parking facilities to meet the needs of the development of driverless technology? etc.

Strengthen the synergistic construction of smart city system and other systems, and synergise the construction of smart city with territorial spatial planning, public safety and security.

Strengthen the synergistic construction of smart city system and other systems, and synergise smart city construction with territorial spatial planning, public security system construction and optimal resource allocation.

Strengthen the synergistic construction of smart city system and other systems, and synergise smart city construction with the needs of territorial spatial planning, public security system construction, optimal resource allocation, etc.

It will also explore the system integration, business synergy and integrated construction techniques of the smart city system.

The conference will explore the system integration, business synergy and integrated construction techniques of smart city system and land spatial information platform, public security and emergency management platform.

Strengthening research on the drivers and dynamic mechanisms of smart cities

Research on influencing factors and driving mechanisms should reflect the principles of comprehensiveness, systemicity and dynamism.

The research on influencing factors and dynamic mechanism should reflect the principles of comprehensiveness, systemicity and dynamism, i.e. to objectively consider the role of all factors on the object of research, in order to

The research on influencing factors and dynamic mechanism should embody the principles of comprehensiveness, systemicity and dynamism, i.e.

That is, the role of all factors on the research object should be considered objectively, and the interrelation and role of each factor should be studied, as well as the dynamic change of each factor on the research object. The research on the influencing factors and dynamics of smart cities includes three main aspects.

The research on the influencing factors and driving mechanism of smart cities mainly includes three aspects: Strengthening the comprehensive research on the influencing factors of smart cities, especially focusing on the current attention on the strengthening the comprehensive research on the influencing factors of smart cities, especially focusing on the factors of social culture, natural environment, openness and cooperation, which have received less attention at present.

In particular, research should focus on factors such as social culture, natural environment, openness and cooperation, which have received less attention.

Indeed, social culture is the connotation and the natural environment is the natural material foundation and spatial carrier of smart city construction, while openness and cooperation are the key to continuously obtaining the benefits from the external environment.

The natural environment is the natural physical foundation and spatial carrier of smart city construction, while openness and cooperation are the key and main driving force to continuously obtain the resources needed for development from the external environment.

Openness and cooperation are the key and main driving force to continuously obtain the resources needed for development from the external environment; Strengthen the systematic research on the impact factors of smart cities.

Strengthen the systematic research on the impact factors of smart cities, and explore the relationship between technological innovation and strengthen the systematic research on the impact factors of smart cities, and explore the interactive and coupling relationship between technological innovation and the system of economic, social, cultural and institutional factors based on the comprehensive analysis of the geographical system of human-land relationship in the smart city, and determine the impact of technological innovation on the smart city.

The study will identify the comparative and competitive advantages of smart city development and guide the development of smart city characteristics;

Strengthen the dynamic research of smart city influence factors, and pay attention to the changes in the importance of influence factors and the dynamic changes in the internal structure of each factor.

In the early stage of smart city development, technology, capital, population In the early stage of smart city development, factors such as technology, capital, population and infrastructure may be the dominant factors.

In the early stage of smart city development, factors such as technology, capital, population and infrastructure may be the dominant factors.

In the middle and late stages of smart city development, factors such as industry, talent, social culture and environment become the new drivers.

In the middle and late stages of smart city development, factors such as industry, talent, social culture and environment become the new dominant factors, and the internal structure of each factor may also change. For example, with technological innovation.

For example, with technological innovation, technologies such as the Internet of Things, big data, cloud computing, artificial intelligence and blockchain have appeared.

Artificial intelligence, cloud computing and blockchain technologies have emerged successively and have gradually and development.

Research on the development path of smart cities adapted to China's national conditions

Based on China's national conditions and the inherent needs of promoting innovative, coordinated, green, open and shared urban development

We will explore the development path of smart cities in accordance with China's national conditions and urban characteristics, so as to fundamentally solve the problem of urban development dynamics.

We will explore the development path of smart cities in accordance with China's national conditions and urban characteristics, and fundamentally solve the

problems of urban development dynamics, uneven development and human and human resources development.

It is also necessary to explore the path of smart city development in accordance with China's national conditions and urban characteristics, so as to fundamentally solve the problems of urban development dynamics, unbalanced development, harmony between man and nature, internal and external linkage of development, and social justice.

Therefore, the next research on the development path of smart cities will mainly include five aspects.

Therefore, the next research on the development path of smart cities will mainly include five aspects: innovation development path research, focusing on the national strategic scientific and technological strength, enterprise technology, and the development of the city.

Research on the innovation development path, focusing on national strategic scientific and technological strength, enterprise technological innovation capacity, talent innovation strength.

Research on the mechanism of national strategic scientific and technological strength, technological innovation capability of enterprises, innovation vigour of talents and scientific and technological innovation system mechanism on the development of smart cities; and

At the same time, actively exploring the realisation of economic, socio-cultural and institutional innovation in smart cities.

Research on coordinated development paths, strengthening economic and social coordination, material and cultural coordination, and coordination between large, medium-sized and small cities and towns in the development of smart cities.

It has also strengthened economic and social coordination, material and cultural coordination, coordination between large, medium and small cities and small towns, coordination between cities and villages, and coordination between regions in the process of developing smart cities.

It will strengthen research on economic and social coordination, material and cultural coordination, coordination among large, medium and small cities and towns, coordination among cities and villages, and coordination among regions in the process of smart city development.

It will also pay attention to the new development pattern in which the domestic macro-cycle is the main body and the domestic and international double cycles promote each other.

It also deals with the coordinated use of domestic and international resources and elements in smart cities under the new development pattern, with the domestic grand cycle as the main body and the domestic and international double cycle promoting each other.

It also explores the comprehensive way for smart cities to achieve coordinated development.

Green development path research

The research on green development path will promote the study of human-land relationship in smart cities.

It will focus on issues such as tightening resource constraints, severe environmental pollution and ecosystem degradation in the development process of smart cities.

It will focus on issues such as the tightening of resource constraints, severe environmental pollution and ecosystem degradation in the course of smart city development, strengthen research on development paths compatible with smart city construction and the resource environment, promote the green transformation of production and living styles in smart cities, and promote the green sustainable development of smart cities.

It will promote the green transformation of production and living styles of smart cities, and promote the green and sustainable development of smart cities;

Open development path research, in the open win-win this

Under the inevitable trend of the development of the times, we will strengthen research on the open cooperation of smart city technology.

Research on the level, quality and internal/external linkage of opening up smart cities to the outside world.

Research on the construction path of a unified sharing and opening platform for smart cities under the trend of orderly opening of basic public information data; The study of shared development path should not only explore the resource elements of government departments, enterprises, scientific research institutes, universities and other subjects in the process of smart city construction, but also explore the development path of smart cities.

The study of shared development paths should not only explore the path of deepening the sharing of resource elements among government agencies, enterprises, research institutes and universities in the process of smart city construction, but also explore the path of sharing technology, experience and achievements among different cities.

We should also explore the mode of sharing technology, experience and achievements among different cities.

3.2. Financial performance forecast for smart cities

Smart cities are a very important source of budget revenue for the modern state. The revenue forecast is shown in Figure 3.3. Over a 10-year budget horizon, revenues increase more than threefold in inflation-adjusted terms. This underlines the importance of financial work in smart cities.

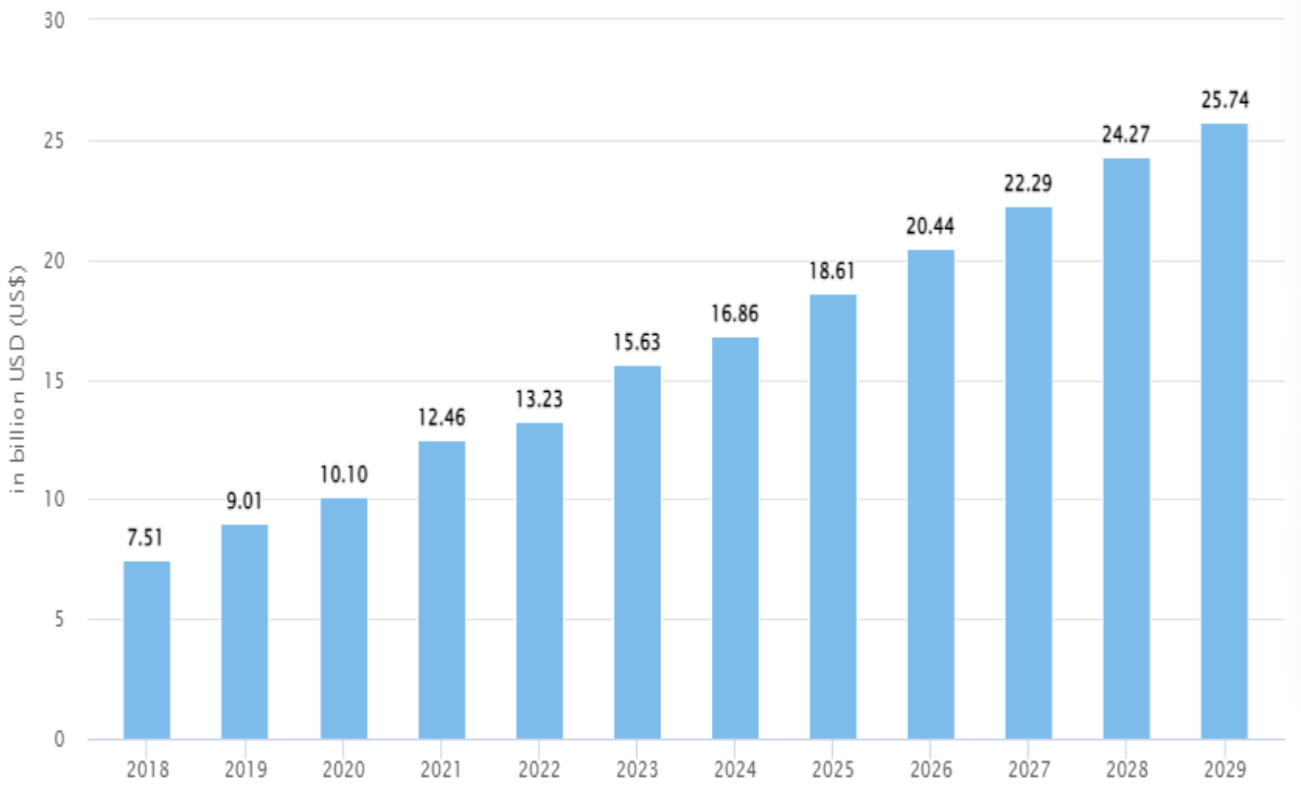

Figure 3.3 – China's smart city revenue dynamics (in billion USD)

Source: Qianji Investment Bank's iFinD asset information network [57]

For an example of tactical budget planning, consider Beijing. 2024 is the 75th anniversary of the founding of New China, a key year for achieving the goals and tasks of the 14th Five-Year Plan, and the 10th anniversary of the implementation of the Beijing-Tianjin-Hebei coordinated development strategy. It is of great significance to do a good job in budget preparation, fully play the role of proactive fiscal policy and provide sound financial support for the economic and social development of the capital.

Revenue and expenditure situation in 2024. Overall, the domestic economy has maintained a positive recovery. The issuance of trillions of yuan in government bonds and the introduction of a series of policies to promote high-quality development have helped to stabilise social expectations and boost economic growth. The accumulation of positive factors such as the capital's scientific and

technological innovation and the continuous consolidation of the results of the city's financial resources construction will lay the foundation for the growth of the city's fiscal revenue. However, factors such as the increasingly complex and challenging external environment, the weak foundation for a sustained economic recovery, the still weak market demand, and the many difficulties in the production and operation of enterprises have imposed certain constraints on the growth of fiscal revenue. At the same time, debt repayments are at a historic high, and key areas such as promoting high-quality economic development and doing practical things for people's livelihoods are in great need of funds. The "tight balance" between fiscal revenues and expenditures will be further exacerbated in 2024.

Guiding Ideology and Principles of Budget Preparation and Fiscal Work in 2024. The guiding ideology of the city's budgeting and fiscal work in 2024 is: guided by Xi Jinping's Thought on Socialism with Chinese Characteristics for a New Era, fully implement the spirit of the 20th National Congress of the Communist Party of China and the Second Plenary Session of the 20th Central Committee, conscientiously implement the spirit of the Central Economic Work Conference, and thoroughly implement the spirit of General Secretary Xi Jinping's important speech on Beijing. Adhere to the general tone of work of seeking progress while maintaining stability; fully, accurately and comprehensively implement the new development concept; adhere to the development of the capital in the new era as the overall guide; thoroughly implement the strategies of Humanistic Beijing, Technological Beijing and Green Beijing; thoroughly implement the coordinated development strategy of Beijing-Tianjin-Hebei; adhere to the "Five Sons" linkage to serve and integrate into the new development pattern; and adhere to high-quality development as the hard truth in the new era.

We will moderately increase the intensity of proactive fiscal policy, improve its quality and efficiency, strengthen the overall planning of fiscal resources, strengthen the coordination and cooperation between fiscal policy and financial, industrial, regional and other policies, ensure that policies work in the same direction and form synergies, and combine the use of various policy instruments such as tax

and fee relief, fiscal subsidies, fiscal interest subsidies and financing guarantees to consolidate the positive economic trend; moderately expand the scale of fiscal expenditure, optimise the structure of fiscal expenditure, make good use of additional funds, and mobilise and adjust existing funds to serve the implementation of major policies and improve people's livelihoods; deeply integrate performance concepts and methods into budget management, improve the performance of fiscal funds, and work hard to implement the requirements of a tight life; strengthen government debt management, ensure the outcome of the "three guarantees" at the grassroots level, strictly enforce financial discipline, and make fiscal contributions to promoting Chinese-style modernisation and serving the high-quality development of the capital.

According to the above guiding ideology, the fiscal management reform in 2024 will focus on the following four principles: First, emphasize people's livelihood orientation. Adhere to the people-centred development philosophy and the characteristics of public finance, stick to doing our best and doing what we can, keep the proportion of people's livelihood expenditure above 80%, and steadily improve people's living standards with the best standards. Second, emphasize the overall direction. Improve the comprehensive budget management system, and integrate all funds from various channels, such as government budget funds, government bond funds, and government investment funds, into the government's coordinated financial resources. Optimise, maintain and reduce the structure of expenditure, and make serving and safeguarding the strategic decisions of the Party Central Committee and the State Council and the operational requirements of the Beijing Municipal Committee of the Communist Party of China the primary task of budget management. Optimise fiscal financing policies to promote industrial development methods, strengthen the decisive role of the market in resource allocation, and better play the role of the government.

Third, emphasize cost reduction and efficiency improvement. Continue to deepen the reform of full-cost performance budget management, further improve the quota standard system for different industries and fields; implement the

requirements of Party and government organs to live a tight life, and strictly arrange the expenditure of routine performance projects of departments. Fourth, emphasize more sustainability. We will promote the expansion of fiscal policy from "balanced and management-oriented" to "strategic fiscal policy", strengthen forward-looking analysis and judgment, and give full play to the counter-cyclical and cross-cyclical regulatory role of fiscal policy. We will coordinate the resolution of local debt risks and stable development, and firmly adhere to the bottom line of no systemic risks. We will strengthen monitoring and early warning of fiscal operations at the grassroots level, and build a solid bottom line of "three guarantees" at the grassroots level.

General arrangement of the city's general public budget

In 2024, the city's general public budget revenue is expected to be 649.02 billion yuan, an increase of 5.0%; plus central government returns and subsidies, general bonds and other budget funds that can be allocated to the general public budget, the total revenue is 910.25 billion yuan. The city's general public budget expenditure is 801.57 billion yuan, an increase of 0.6%. The slightly lower increase is mainly due to the unified requirements for budget compilation. At the beginning of the year, only the transfer payment funds and the newly added general bond quota issued in advance by the central government are included in the budget. In the future, the transfer payment and the newly added general bond quota issued by the central government during the annual execution will be well used to further increase the scale of expenditure; together with the expenditure of 108.68 billion yuan for the repayment of central and local government bonds and the use of local special policy carryovers in the next year, the total expenditure is 910.25 billion yuan. The city's general public budget achieves a balance between revenue and expenditure.

General arrangements for the city's general public budget. In 2024, the city's general public budget revenue is expected to be 355.0 billion yuan, an increase of 5.0%; plus central subsidy revenue of 113.23 billion yuan, district transfer of 47.49 billion yuan, local special policy transfer of 1.34 billion yuan, local government bond revenue of 38. 15 billion yuan, government fund budget transfer of 1.03 billion

yuan, state-owned capital operation budget transfer of 1.85 billion yuan, and budget stabilisation adjustment fund of 8.96 billion yuan, the total revenue is 567.05 billion yuan. The city's general public budget expenditure is 526.36 billion yuan, of which: local financial expenditure is 440.96 billion yuan, an increase of 1.4%; infrastructure expenditure is 47.0 billion yuan, an increase of 9.3%; central special and common affairs transfer payment arrangement expenditure is 38.4 billion yuan. Including the central government expenditure of 11.8 billion yuan, the repayment of local government bonds of 16.75 billion yuan, the repayment of loans from international organisations of 0.4 billion yuan and the on-lending expenditure of local government bonds of 12.1 billion yuan, the total expenditure is 567.05 billion yuan. The general public budget of the municipality achieved a balance between revenue and expenditure.

In 2024, the budget for the fiscal expenditure of the "three public expenses" of municipal Party and government organs and institutions is 650 million yuan, a decrease of 4.0%, mainly due to the conscientious implementation of the Central Eight Regulations and the relevant work requirements of the municipal Party committee and municipal government, strict control of administrative expenses, and further compression of the "three public expenses". This includes 140 million yuan for official overseas travel; 20 million yuan for official receptions; 490 million yuan for the purchase and operation and maintenance of official vehicles (including 140 million yuan for purchase and 350 million yuan for operation and maintenance).

In 2024, the city will allocate 208.18 billion yuan for system returns and transfer payments to counties. Excluding the central transfer payment factor, the growth rate is 3.3%. The city's system returns and general transfer payments to the counties will mainly be used to promote the equalisation of basic public services and improve the level of regional coordinated development; solidly carry out the action of promoting decongestion and rectification, continue to promote the renovation of old residential areas and apply for the withdrawal of the whole courtyard to improve the urban quality; increase support for financial construction and promote industrial transformation and upgrading; encourage and guide ecological protection areas to

fulfil ecological protection responsibilities and speed up the construction of beautiful villages. Special transfers will mainly be used to further promote the universalisation and inclusive development of pre-school education, promote the improvement of the environment in key areas, support afforestation and greening and the construction of a water-saving society, and promote the continuous improvement of the ecological environment.

In 2024, by adjusting the expenditure structure and increasing the scale of general budget investment, the city government will arrange fixed asset investment of 72.0 billion yuan, an increase of 5.9%. Among them: 47.0 billion yuan will be arranged in the general public budget, and 25.0 billion yuan in the government fund budget. It will mainly be used to ensure the coordinated development of Beijing, Tianjin and Hebei, the construction of an international science and technology innovation centre, ecological protection, improvement of people's livelihood, post-disaster reconstruction and rehabilitation, and other areas of municipal key fixed asset investment projects.

Municipal expenditure policy and protection priorities.

The fiscal expenditure policy in 2024 will mainly implement the decisions of the CPC Central Committee and the State Council, implement the arrangements of the municipal Party committee and municipal government, coordinate funds, optimise structure, ensure the expenditure needs of municipal departments and key areas of each district, increase support for key areas such as scientific and technological innovation and people's livelihood security, and promote the high-quality development of the capital.

Expenditure on education was 49.69 billion yuan. Of this, the expenditure of funds provided by local financial resources was 44.89 billion yuan, an increase of 1.5%, including 30.38 billion yuan at the municipal level and 14.51 billion yuan in transfers from the municipality to the counties. The main purpose is to continue to support the construction of a high-quality education system in the capital. The focus will be on promoting the construction of primary and secondary school places, adding 20,000 new primary and secondary school places; further deepening the

"double reduction" work, strengthening psychological counselling for young people; speeding up the construction of the childcare system and implementing the financial subsidy policy for universal kindergartens; supporting the improvement of the quality of vocational education and building high-level vocational secondary schools; implementing various policies such as student support; and promoting the classified high-quality development of municipal universities.

44.58 billion yuan was spent on science and technology. Among them: 42.56 billion yuan was allocated from local funds, an increase of 1.2%, including 42.26 billion yuan at the municipal level and 300 million yuan in transfers from the municipality to the counties. The main purpose is to accelerate the construction of an international science and technology innovation centre. Focus on implementing the Regulations on the Construction of the Beijing International Science and Technology Innovation Centre and further increase fiscal investment in science and technology innovation. Support the research and development of key core technologies, ensure the orbital operation and systematic development of national laboratories in Beijing; Accelerate the construction of world-leading science and technology parks, focus on supporting the coordinated development of "three cities and one district", strengthen the original innovation source function of Zhongguancun Science City, accelerate the cluster application of key science and technology infrastructure in Huairou Science City, enhance the technological innovation capability of the future science city, and promote the innovative industrial cluster demonstration zone to make more scientific and technological achievements; deepen the reform of the management of fiscal research project funding and stimulate the vitality of innovation units.

15.61 billion yuan was spent on cultural tourism, sports and media. Among them: 13.96 billion yuan was allocated for funding by local financial resources, an increase of 0.2%, including 11.0 billion yuan of municipal expenditure and 2.96 billion yuan of municipal transfers to counties. The main purpose is to further promote the construction of the National Cultural Centre. Focus on supporting the operation and maintenance of public cultural institutions such as the Beijing Art

Centre; improve the level of protection of cultural relics; support the repair and protection of key cultural relics and revolutionary historical relics in the "one city, three belts" area; support the high-quality development of the tourism industry throughout the region; support the accelerated development of the sports industry; and promote sports consumption; Promote the transformation and upgrading of physical bookstores, support the compilation and publication of excellent old books; continue to hold cultural activities that benefit the people, and support major events such as the Beijing International Film Festival and the International Music Festival.

Expenditure on social security and employment amounted to 43.91 billion yuan. Among them: 22.78 billion yuan of expenditure was provided by local funds, an increase of 1.9%, including 18.64 billion yuan at the municipal level and 4.14 billion yuan in transfers from the municipality to the counties. The main purpose is to improve the social security system and support stable employment. Focus on securing pension benefits for preferential and relief beneficiaries and improving the service and guarantee system for retired soldiers; increase the supply of high-quality elderly care services and build 100 new street (township) regional elderly care service centres; coordinate the use of tax reductions and exemptions, interest subsidies for business guarantee loans and other policies to help key groups such as college graduates and retired soldiers find jobs; conduct vocational training to improve the professional skills of talents.

29.89 billion yuan was spent on health care. Among them: 23.16 billion yuan was allocated from local funds, which was basically the same as the previous year, including 21.32 billion yuan at the municipal level and 1.84 billion yuan in transfers from the municipality to the districts. The main purpose is to continue to promote the construction of a healthy Beijing. The focus is on optimising the layout of medical resources, promoting the smooth opening of the Tongzhou (Phase II) and Shunyi branches of the Friendship Hospital and the Huilongguan branch of the Jishuitan Hospital, improving the level of diagnosis and treatment of critical illnesses such as emergencies, improving the hierarchical diagnosis and treatment service system, increasing support for community health services and medical

institutions, strengthening the construction of the paediatric service system and talent team, improving the health service system for the elderly, enhancing the service capacity of traditional Chinese medicine at the grassroots level, and improving maternity support policies.

15.21 billion yuan was spent on energy conservation and environmental protection. Among them: 14.21 billion yuan was allocated for local funding, down 10.9%, mainly due to the elimination of subsidies for new energy vehicles and the reduction of subsidies to power companies; of which 10.20 billion yuan was allocated at the municipal level and 4.01 billion yuan was transferred from the municipality to the districts. This is mainly to implement the Green Beijing Strategy. We will focus on supporting the in-depth battle to protect blue skies, clear water and clean land; continue the "One Microgram" campaign; strengthen the comprehensive management of key river basins such as the Yongding River and Chaobai River; vigorously develop green and low-carbon industries; and support low-carbon technology research and low-carbon pilot projects.

39.24 billion yuan was allocated for urban and rural community spending. Among them: 23.84 billion yuan was allocated from local financial resources, an increase of 1.9%, including 22.58 billion yuan at the municipal level and 1.26 billion yuan in transfers from the municipality to the counties. The main purpose is to support the creation of a more liveable city. The focus is on supporting the comprehensive improvement of the environment, promoting the construction of a garden city, building 50 small green areas and pocket parks, and promoting the long-term classification of domestic waste; accelerating the construction of smart cities, and deepening the promotion of "one-stop service", "one-network unified management", and "one-network smart governance".

21.08 billion yuan was spent on agriculture, forestry and water. Among them: 19.74 billion yuan was allocated for financing from local financial resources, which was basically the same as the previous year, including 9.57 billion yuan at the municipal level and 10.17 billion yuan in transfers from the municipality to the counties. This is mainly to support the comprehensive implementation of the rural

revitalisation strategy. Focus on promoting the revitalisation of the agricultural industry, supporting the development of leisure agriculture and other advantageous and characteristic industries in various districts, accelerating the construction of Zhongguancun in agriculture and creating a "seed industry capital"; implement policies that benefit farmers, promote the stable production and supply of key agricultural products; Implement a new round of "100 villages demonstration, 1,000 villages revitalisation" projects, and promote the construction of livable, business-friendly and beautiful villages; deepen cross-regional ecological environment coordinated management, and implement joint measures for water ecological protection in the Miyun Reservoir Basin in Beijing and Hebei; support embankment survey, concealment and reinforcement, and mountain torrent channel management to improve the basin's flood control capacity.

31.08 billion yuan was allocated to transport expenditure. Among them: 29.31 billion yuan was allocated from local funds, which was basically the same as last year, including 29.27 billion yuan at the municipal level and 40 million yuan in transfers from the municipality to the counties. It is mainly to support the construction of a modern urban transport system. The focus is on improving the operational safety and service level of rail transport, and completing and opening the first phase of the western section of Metro Line 3 and the western section of Line 12; expanding the pilot scope of public transport for school and medical care, and continuing to promote comprehensive traffic management around key areas such as hospitals, schools and business districts; supporting the repair of damaged roads, the renovation and upgrading of national and provincial roads, and the construction of expressways; accelerating the construction of integrated transport in the Beijing-Tianjin-Hebei region, and promoting the integration of commuter circles around Beijing.

1.8 billion yuan was allocated to commercial services and other expenditure. Of this, 1.33 billion yuan was allocated for financing from local financial resources (municipal expenditure), an increase of 2.2%. The main purpose is to accelerate the construction of an international consumer centre city. The focus is on supporting the

transformation and upgrading of business districts and building new consumer landmarks; increasing support for the transformation and upgrading of logistics bases and wholesale markets for agricultural products; promoting the construction of a "15-minute convenient living circle" to improve the quality of living services; actively cultivating digital consumption and green consumption; and promoting the cross-border integration of business, travel, culture and sports.

Housing security expenditure amounted to 1.51 billion yuan, all of which was expenditure financed by local funds (municipal expenditure), down 34.3%, mainly due to the adjustment of part of municipal expenditure to support the implementation of urban renewal policies in various districts. The focus was on supporting the construction and financing of public rental housing, increasing the construction and supply of affordable housing, preparing the construction of 70,000 affordable rental housing units, and completing 80,000 affordable housing units of various types.

3.66 billion yuan was allocated to disaster prevention and emergency management. Including: 1.85 billion yuan was allocated for local financial resources, a decrease of 21.7%, mainly due to the high base of one-time disaster relief expenditure in 2023 to cope with the "23.7" extreme heavy rainfall, including 1.72 billion yuan at the municipal level and 130 million yuan in transfer payments from the municipality to the counties. The main purpose is to strengthen the construction of resilient cities; focus on supporting the construction of disaster prevention and mitigation systems and projects; promote the construction of disaster prevention and control systems; strengthen the guarantee of emergency materials, teams, facilities, etc.; and enhance the rescue and disposal capabilities of all kinds of disasters.

5.38 billion yuan was allocated for aid to other regions, all of which was spent from local funds (municipal expenditure), an increase of 0.3%. It was mainly to support the further development of the recipient regions such as Xinjiang, Tibet, Qinghai, Inner Mongolia, Hubei, Henan and Shanxi, and to consolidate and expand the results of counterpart assistance.

Overall arrangement of government fund budget.

In 2024, the city's government fund budget revenue is expected to be 200.21 billion yuan, a decrease of 5.1%, mainly due to the comprehensive consideration of factors such as the location of listed land and land market expectations; plus central transfer payment income, transferred funds, special debt income and local special policy carryovers from the previous year, the total revenue is 373.71 billion yuan. Government fund budget expenditure is 207.99 billion yuan, down 24.0%, mainly because the central government has not yet issued some local special bond quotas; plus transferred funds, debt repayments, local special policy carryovers for next year, total expenditure is 373.71 billion yuan. The city's government fund budget achieves a balance between revenue and expenditure.

In 2024, the budget revenue of the local government fund is expected to be 56.06 billion yuan, a decrease of 18.7%. This is mainly due to the combination of land distribution and land cost-benefit structure, etc., to increase support for district-level land revenue and promote the acceleration of key infrastructure construction in various districts; plus the central special transfer payment income of 440 million yuan, special debt income of 141.47 billion yuan (new special bonds of 51.0 billion yuan, refinancing special bonds of 90.47 billion yuan), district transfer income of 700 million yuan, and local special policy carryover of 6.05 billion yuan in the previous year, with a total revenue of 204.72 billion yuan. The expenditure of the municipal fund budget is 64.84 billion yuan, of which: the local financial resources arrange the expenditure of 39.4 billion yuan, an increase of 3.9%; the infrastructure expenditure is 25.0 billion yuan, the same as last year; the central special transfer payment arrange the expenditure of 440 million yuan.

In accordance with the principle of "spending according to income and using special funds for special purposes", it will mainly be used to ensure the implementation of projects such as land reserve development, urban construction and shanty town reconstruction, to support the development of social welfare and sports, and to ensure the normal operation of lottery sales agencies. In addition, 1.03 billion yuan of funds were transferred out, 120 billion yuan of special debt loan expenditures (45.82 billion yuan of new debt loans, 74.18 billion yuan of refinancing

debt loans), 16.29 billion yuan of special debt repayment, and 2.56 billion yuan of local special policy transfers for use next year, with total expenditures of 204.72 billion yuan. The local government fund budget achieved a balance between revenue and expenditure.

Overall Arrangement of State-Owned Capital Operation Budget. In 2024, the revenue of the city's state-owned capital operation budget is expected to be 5.88 billion yuan, a decrease of 14.5%, mainly due to the impact of factors such as the macroeconomic situation and industrial policy regulation. The economic benefits of municipal state-owned enterprises in 2023 have declined, as well as the reduction of government equity investment exit projects and the decline of one-off income. With the addition of 0.9 billion yuan in central special transfer payments and 1.49 billion yuan in income carried over from the previous year, the total revenue is 7.46 billion yuan. The city's state-owned capital operation budget expenditure is 5.35 billion yuan, an increase of 13.3%, mainly due to the increase in the previous year's over-collection and central transfer payment funds and the corresponding increase in expenditure arrangements; with the addition of 2.11 billion yuan in funds transferred to the general public budget, the total expenditure is 7.46 billion yuan. The city's state-owned capital operation budget achieves a balance between revenue and expenditure.

In 2024, the municipal state-owned capital operation budget revenue is expected to be 5.24 billion yuan, a decrease of 11.6%; plus the central special transfer payment revenue of 0.9 billion yuan and the carry-over revenue of 9.2 billion yuan from the previous year, the total revenue is 6.25 billion yuan. The municipal state-owned capital operation budget expenditure is 4.31 billion yuan, an increase of 4.3%, mainly to support the development of high-tech industries in the fields of digital economy and hydrogen energy equipment, and to improve the technological innovation of state-owned enterprises and the investment and operation functions of state-owned capital; plus the central special transfer payment allocation of 0.9 billion yuan to each district, and 1.85 billion yuan transferred to the general public budget, the total expenditure is 6.25 billion yuan. The operating

budget of the municipal state-owned capital achieves a balance between revenue and expenditure.

General arrangement of the social insurance fund budget. In 2024, the city's social insurance fund budget revenue is expected to be 655.12 billion yuan, an increase of 1.8%, mainly considering the basic stability of the payment rate and the number of contributors, and the increase of the payment base. The budget expenditure of the social security fund is 475.85 billion yuan, an increase of 11.6%, mainly taking into account the adjustment of pensions, the increase in the number of retirees and the increase in the number of medical visits. The surplus of revenue and expenditure for the year is 179.27 billion yuan.

For details of the above budget arrangements and related explanations, please see "Beijing's 2023 Budget Implementation and 2024 Budget".

Effective implementation of the 2024 tax administration reform work

1. Adhere to the principle of seeking progress while maintaining stability, promote stability through progress, establish before breaking, and continue to promote economic recovery and improvement.

We will coordinate the current and long-term development, vigorously strengthen the financial resources construction, and support the creation of the "Beijing Service" brand for the business environment. We will make good use of fiscal policy tools, such as the first loan subsidy for small and medium-sized enterprises and the financing of government procurement contracts, to help enterprises solve problems such as high financing costs and insufficient market development. We will implement the policy of continuous reduction of taxes and fees, and take more effective measures to support and assist enterprises.

Focusing on the concerns and needs of enterprises, we will strive to alleviate their difficulties and promote the development and growth of the private economy and small and medium-sized enterprises. We will seize the opportunity to deepen the construction of the National Comprehensive Demonstration Zone for Expanding Opening-up of the Service Industry, promote and support the development of advantageous industries such as telecommunications, healthcare, finance, culture

and education, and cultivate new forms. We will promote the coordinated integration and complementarity of career and industrial development in the field of people's livelihood, and build a new system of high-quality and efficient service industries guided by people's livelihood needs. We will actively lay out the key tracks of the digital economy, promote the development of the digital economy, and accelerate the construction of a global benchmark city in the digital economy. We will give full play to the role of newly established government investment funds in artificial intelligence, medical health, robotics and information industries.

The fiscal budget will maintain stable investment in government investment funds, enhance the leading role of government investment funds, and support the establishment of technological innovation, high-tech and future industries in the capital. Give full play to the amplifying effect of scientific and technological innovation funds, high-tech funds, etc., and use more social capital to participate in scientific and technological innovation. Actively compare with international high-standard economic and trade rules, and deepen the reform of the government procurement system. Further strengthen the basic position of competition policy, improve the fair competition examination of fiscal policies, and maintain a fair competition market order. Make good use of local government bond funds, accelerate the progress of bond fund spending, and better stimulate investment.

Focus on people's livelihood and continue to improve their well-being. We will continue to protect and improve people's livelihoods in the process of development, improve the mechanism for guaranteeing investment in people's livelihoods, promote the coordination of spending on people's livelihoods with economic development and adjust it to financial conditions, and ensure that investment in people's livelihoods continues to exceed 80%. We will make good use of funds, such as the additional issuance of treasury bonds by the central government, comprehensively promote post-disaster reconstruction and rehabilitation, and improve the policy system and financing guarantee mechanism for post-disaster reconstruction and rehabilitation of major natural disasters. We will speed up the construction of a high-quality education system, improve the fiscal

guarantee standard of public funds per pupil in basic education, and promote the high-quality and balanced development of basic education. We will weave a tight and solid social security safety net and provide a basic livelihood guarantee for families and individuals in difficulty.

We will speed up the construction of a healthy Beijing, further deepen the reform of the medical and health system, and promote the development of high-quality medical resources and balanced regional planning. We will support the implementation of urban renewal policies, start 300 new comprehensive renovations of old communities, complete 200, start 1,000 lifts in old buildings, and complete 600. We will accelerate the construction of affordable housing, the construction of public infrastructure for both peacetime and emergency use, and the transformation of urban villages, etc.

Adhere to overall planning and balance, and continuously improve fiscal guarantee capacity.

On the basis of strengthening the coordination and linkage of the government's "four budgets", we will further enhance the coordinated use of various types of funds and assets, such as government bonds, existing funds and assets, and departmental non-fiscal funds, realise full-calibre budget management, and improve the financial support capacity for major national strategic tasks. Adhere to the government's tight budget, strictly control general expenditures, continue to make assessments of the tight budgets of government departments, link the assessment results to next year's budget arrangements, and release more financial resources for use in key development areas and urgent people's livelihood needs. Prepare a detailed and practical three-year rolling budget and improve the cross-cycle coordination and dispatch mechanism for project budgets. Tighten budget constraints, strictly implement the budget reviewed and approved by the Municipal People's Congress, and strictly prohibit overspending, unbudgeted spending and government procurement.

Adhere to reform and innovation and further deepen budget management reform. Formulate working standards for full-cost performance analysis in key areas,

strengthen the link between cities, districts, roads and towns, and consolidate the results of full-cost performance budget management reform. Select some secondary budget units to pilot the preparation of overall performance targets. Carry out performance evaluation of existing expenditure policies, such as afforestation and maintenance, in a hierarchical and classified manner, and improve, optimise or clean up and integrate policies based on the evaluation results. Guide units to strengthen the primary responsibility of project management and improve the effectiveness of ex-ante evaluation work. Improve the quota standard system for various industries and fields, improve the general quota standards for municipal water and electricity charges and operation and maintenance of new energy vehicles, strengthen the application of expenditure standards, and give full play to the basic role of quota standards in budget preparation. Continue to increase the intensity of financial budget review for key projects, and rely on scientific and refined management methods to help projects land in a timely and efficient manner. Strengthen the management of the entire life cycle of projects, promote the normalisation of budget expenditure projects, distinguish priorities and strengthen the management of project sequencing.

Adhere to the bottom line thinking and effectively prevent and solve financial risks. Better coordinate development and security, insist that debt accumulation should be in line with debt repayment capacity, improve the full lifecycle management mechanism of standardised debt accumulation, efficient debt use, scientific debt management and timely debt repayment, and firmly adhere to the bottom line of no systemic risks, while effectively supporting high-quality economic and social development. Continue to optimise the structure of transfer payments from the city to the counties, adhere to the priority of "three-guarantee" spending in fiscal spending, improve the full process management of the "three-guarantee" budget, strengthen the dynamic monitoring of "three-guarantee" spending in various counties, and fully incorporate "three-guarantee" spending into budget arrangements to ensure that all guarantees are met. Establish and improve the cash flow forecasting mechanism, conduct risk warnings for key areas in advance, optimise the timing of

fiscal expenditures, and ensure the smooth operation of cash funds throughout the city.

Strictly enforce financial discipline, standardise revenue and expenditure behaviour, and ensure the safety of financial resources. Continue to improve the coordinated working mechanism of the "five kinds of supervision", such as discipline inspection and supervision, inspection and control, auditing, accounting and statistics, earnestly accept the supervision of the Municipal People's Congress and its Standing Committee, and establish supervisory synergy. Continue to enrich the content of budget and final accounts disclosure, and actively accept social supervision.

To conclude the consideration of budget planning in smart cities, it is worth noting the importance of local finance in China's fiscal policy. Figure 3.4 shows the structure of revenue and expenditure at the national and local levels.

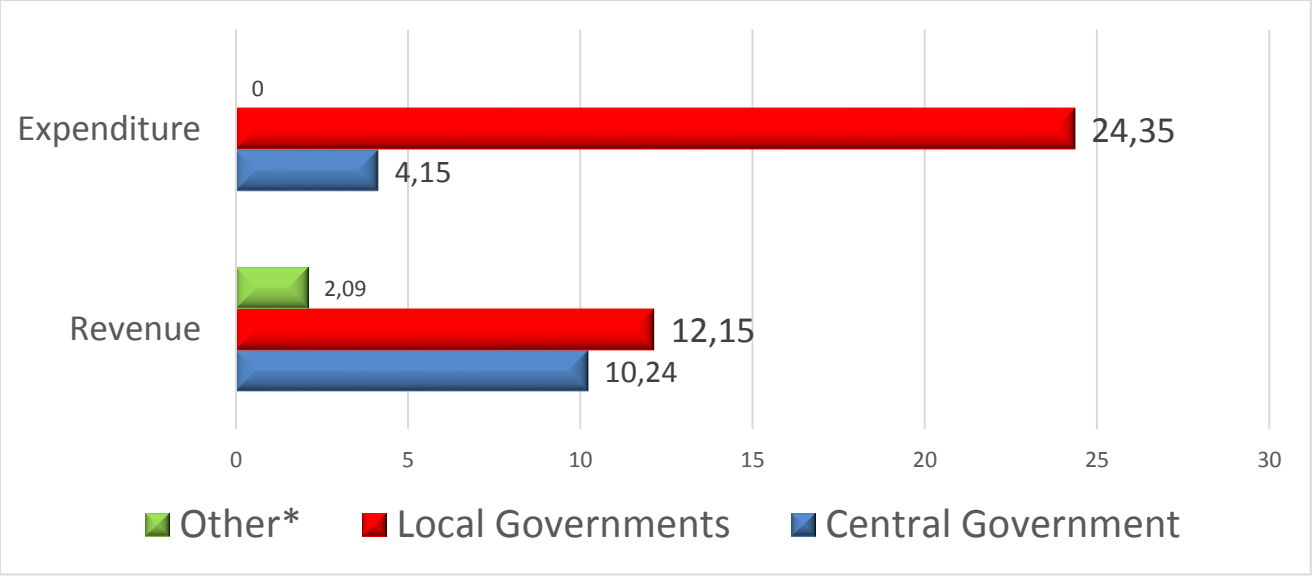

Figure 3.4 – China's 2024 National General Public Budget (Trillions of RMB)

Source: CSIS China Power Project; Chinese Ministry of Finance [12]

Figure 3.3 clearly shows that the main source of revenue at the state level is revenue generated at the local level. However, local budget expenditure is the main source of budget deficit. Under such conditions, an effective fiscal policy of financing smart cities can increase revenues and reduce expenditures of local budgets, which will make it possible to balance the budget.

CONCLUSIONS

The Master's thesis presents the essence of financing the development of smart cities. The main challenge today was to develop a framework for implementing smart city financing in a sustainable way.

Smart technologies are based on the application of IT, information and innovation to achieve sustainable development of smart cities. The impact of each system is defined by matching criteria: Intelligent infrastructure ensures a comfortable, efficient and sustainable urban environment; Intelligent transport enables you to improve flow and mobility, reduce environmental impact, increase safety and convenience for citizens; Intelligent governance makes a significant contribution to resource development and improves quality of life with sustainability of population growth; Intelligent environment helps to preserve natural resources, reduce negative impact on the environment and improve quality of life for the population; intelligent services create the conditions for the sustainability of health, finance, economy and tourism, contributing to a comfortable and efficient environment for consumers, quality and availability of various services; intelligent people contribute much to the development and application of information technologies in connection with the Internet; smart life provides for a continuous development of citizens through the use of technology in everyday economy; and the rational economy provides for a more efficient economy.

The high potential for the introduction of urban technologies in the USA is characterised by the country's scientific centres and the simultaneous development of innovative services. The importance of the balance between scientific research, innovative material production and services in the development of smart cities is assumed.

Despite the fact that technology should theoretically compensate for territorial advantages, the highest Smart City Index scores in the US are spatially heterogeneous. This observation once again confirms the importance of geography

in post-industrial society, where technology is becoming the main mediator between people and the city.

The future development of China's smart cities is expected to lead to breakthroughs and innovations in many aspects. First, technological integration will be deeper. As technologies such as 5G, artificial intelligence, big data, cloud computing, and the Internet of Things develop and become popular, it is expected that these technologies will be more closely integrated to form a smarter and more efficient urban management and service system. The integration of technologies will not only increase the efficiency of the city, but also significantly improve the living experience of residents.

Second, urban governance will become more sophisticated. With the application of advanced technologies, the capabilities of urban governance will be further improved. Smart cities are expected to achieve more precise resource allocation, more efficient urban planning, and more effective public services in the future. At the same time, smart cities will play a greater role in improving urban safety, environmental protection and sustainable development.

Public participation will also be strengthened. The development of smart cities is not only driven by technology and policy, but also requires broad public participation. It is expected that in the future, smart cities will pay more attention to the needs and experiences of residents, and contribute to making smart city services more humane and personalised.

Finally, coherent regional development will become a trend. As regional economic integration deepens, smart cities will form a network of closer cooperation in the region. Through data sharing, optimised resource allocation and joint management, smart cities will play a greater role at the regional level and contribute to the coordinated development of urban agglomerations in the region.

Qianji Investment Bank believes that the future development of China's smart cities will be a comprehensive process driven by technology, resident engagement, improved governance and regional cooperation, which will help cities develop in a smarter, more efficient and more livable direction.

The rapid development of urbanisation has brought about a series of problems, which in turn require constant and timely adjustment of the industrial structure of cities, overcoming various emergencies, improving the living environment of urban residents, etc. The concept of the new smart city aims to continuously promote reform and innovation to improve public services, enhance city management, and provide a suitable and safe living environment. The concept of the new smart city aims to continuously promote reform and innovation to improve public services, enhance urban management and create a suitable and safe living environment.

The rapid development of smart city construction practice has put higher demands on the theoretical exploration and research of China's smart city.

Theoretical exploration and research of the city has become more demanding. In the past decade, scholars have focused on the perspective of conceptual connotation, development stage, system framework, influence mechanism, function and application of smart city, scholars have conducted multidisciplinary research.

System, influence mechanism, functional application and other perspectives, and have conducted multidisciplinary research. In particular, urban science and information science have promoted the research paradigm of smart city from technology-driven to human-centred.

In particular, the exploration in the fields of urban science and information science has promoted the research paradigm of smart city to expand from technology-oriented to human-oriented and socio-economic system integration.

This has highlighted the role of smart city construction in promoting new urbanisation and enhancing sustainable development.

It highlights the role of smart city construction in promoting new urbanisation and enhancing sustainable development. On this basis, the importance of interdisciplinary and multidimensional smart city research is further emphasised.

On this basis, the importance of interdisciplinary and multidimensional smart city research is further emphasised, and smart city system, smart city simulation, smart city human-land system synergy are proposed and put forward the future key research directions, such as smart city system, smart city simulation, smart city

human-land system synergy, smart city driving mechanism and construction path, and so on.

It will provide guidance for the future practice of smart city construction.

The concept of a 'smart city' helps to ensure the efficient functioning of modern cities, taking into account the needs of their inhabitants. A smart city can be seen as an innovative system that uses sensors, the Internet of Things (IoT), networks and big data to increase the competitiveness and efficiency of city services. The sustainable development of a smart city should take into account economic, social and environmental aspects and ensure that it meets the needs of current and future generations.

The development of smart cities involves the integration and coordination of services in cities and the possibility of remote citizen participation in city management.

3rd October 2024 Ju Chengeng

I consider it possible to admit Master Ju Chengeng's qualification work to the defence.

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ANNEXES

Annex A.

Table A.1.

Implementation of general public budget revenue in Wuxing District, Huzhou City in 2023

(Unit: Ten thousand yuan)

subject	2022 Achievements	Expected number in 2023	2023 Executions	Expected % completed	±% compared with the previous year's performance
Total general public budget revenue	624,873	662,366	665,600	100.49	6.52
1. Subtotal of tax revenue	560,749	594,570	573,536	96.46	2.28
1. Value Added Tax (50%)	151,820	154,456	229,972	148.89	51.48
2. Corporate income tax (40%)	120,853	128,000	85,888	67.10	-28.93
3. Personal income tax (40%)	27,775	33,794	21,573	63.84	-22.33
4. Urban maintenance and construction tax	24,363	29,000	23,231	80.11	-4.65
5. Other local taxes	135,049	164,296	127,894	77.84	-5.30
Including: Resource tax	7,597	10,000	8,507	85.07	11.98
Property Tax	34,581	41,719	38,989	93.46	12.75
Stamp Duty	8,665	11,000	13,459	122.35	55.33
Urban land use tax	17,963	22,878	13,596	59.43	-24.31
Land value-added tax	59,151	69,399	45,658	65.79	-22.81[Note 2]
Vehicle and vessel tax	6,946	9,000	7,241	80.46	4.25
Environmental Tax	142	300	408	136.00	187.32
Other tax revenues	4		36		800.00
6. Cultivated land occupation tax	29,603	14,484	17,686	122.11	-40.26
7. Deed Tax	71,286	70,540	67,292	95.40	-5.60
2. Subtotal of non-tax revenue	64,124	67,796	92,064	135.80	43.57
1. Special income	23,196	25,596	26,025	101.68	12.20
2. Income from administrative and institutional fees	12,505	17,200	8,772	51.00	-29.85
3. Confiscation income	22,524	22,000	8,896	40.44	-60.50
4. Other income	5,899	3,000	48,371	1,612.37	719.99[Note 3]
Appendix: Total budget revenue	1,002,037	1,062,113	1,059,575	99.76	5.74
[Note 1] This is mainly due to the large amount of VAT refunds last year, resulting in a low base					
[Note 2] Mainly to implement the policy of guaranteed delivery of buildings and appropriately postpone the settlement of land value-added tax					
[Note 3] Mainly income from mining rights and auction of earth and stone materials					

Annex B.
Table B.1.

Implementation of general public budget expenditure in Wuxing District, Huzhou City in 2023

(Unit: Ten thousand yuan)

subject	2022 Achievements	Budget for 2023	2023 Adjusted Budge	2023 Executions	% of budget adjustment completed	±% compared with the previous year's performance
[Total general public budget expenditure]	691,239	724,828	731,402	702,017	95.98	1.56
I. General public service expenditure	64,888	67,826	67,826	65,984	97.28	1.69
2. Public Security Expenditure	40,321	42,297	43,225	40,865	94.54	1.35
III. Education Expenditure	138,139	145,719	145,818	144,510	99.10	4.61
IV. Expenditure on Science and Technology	24,154	27,792	27,792	27,856	100.23	15.33
5. Expenditure on Culture, Tourism, Sports and Media	9,343	9,836	10,639	8,991	84.51	-3.77
VI. Social Security and Employment Expenditure	123,693	136,833	136,903	132,630	96.88	7.23
VII. Health Expenditure	90,971	79,483	87,301	77,928	89.26	-14.34
8. Energy conservation and environmental protection expenditures	15,233	15,917	15,717	14,323	91.13	-5.97
IX. Urban and Rural Community Expenditure	36,831	39,467	40,183	39,107	97.32	6.18
10. Agriculture, forestry and water expenditure	42,927	45,197	46,919	48,873	104.17	13.85
11. Transportation Expenditure	13,009	14,002	14,002	13,404	95.73	3.04
12. Expenditure on resource exploration information, etc.	36,179	37,216	37,216	26,678	71.68	-26.26
13. Expenditure on commercial services, etc.	12,633	12,333	13,774	11,791	85.61	-6.66
14. Financial Expenditure	3,333	3,035	3,035	2,952	97.28	-11.42
15. Expenditure on Natural Resources, Oceanography, Meteorology, etc.	5,742	7,902	7,902	14,129	178.80	146.07[Note 1]
16. Housing Security Expenditure	8,066	7,400	7,400	7,409	100.13	-8.14
17. Disaster Prevention and Emergency Management Expenditure	5,501	5,953	6,248	5,071	81.15	-7.82
18. Other Expenses	1,096	307	307	307	100.00	-71.99
19. Debt interest payments and issuance expenses	19,180	19,013	19,195	19,209	100.07	0.15
20. Reserve Fund		7,300				
[Note 1] This is mainly due to the transfer payment from higher authorities for projects such as land development and reclamation and reservoir resettlement special funds, which increased significantly compared with the same period last year.						