Promote New-Type Urbanization with Smart Infrastructure

Based on the Perspective of Urban High-Tech Public Products in China

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Abstract. This paper attempts to use relevant data of public products and macroeconomic, from the view of technical characteristics of smart infrastructure, to analysis the feasibility of smart infrastructure to provide high-level public products and the problems encountered in this process. The research conclusion shows that China builds new-type urbanization through the construction of smart infrastructure is conducive to promote the new technological revolution, the construction of smart infrastructure requires comprehensive designing and overall planning, and the production of any public products should be people-oriented. The conclusions above also apply to most developing countries.

Keywords: New-Type urbanization · Smart Infrastructure · People-Oriented Urbanization · Public Product

1 Introduction

China is a developing country with a population of more than 1.4 billion. Before the Reform and Opening Up, the level of urbanization was not high, and the majority of people lived in rural areas, formed an urban-rural dual structure. The urban-rural dual structure results in insufficient supply of public products and unequal public services. In particular, rural residents cannot enjoy the same public services as urban residents because public infrastructure and public service facilities in rural areas lag behind those in cities, which is not conducive for people's development and modernization. After 1978, under the background of Reform and Opening Up, China began to gradually integrate into the world. As a result, fundamental changes took place in the industrial structure, that is, the manufacturing and trade industries developed rapidly. The change of industrial structure produced a huge demand for labor force, and the surplus rural population began to flow to manufacturing, commerce and trade, and from rural move to city. After entering the 21st century, the population flow is accelerating year by year, which brings

N. Radojević et al. (Eds.): ICAID 2022, AHIS 7, pp. 896–909, 2023.
https://doi.org/10.2991/978-94-6463-010-7_90

great challenges to the urban carrying capacity. The trend of rural migration to cities is irreversible and will accelerate. Therefore, the China government has put forward the development strategy of urbanization.

With the development of economy and society, Chinese people are increasingly pursuing high quality of life and need higher requirements for the supply of public products and services. In order to meet this demand of urban residents, the China government has put forward plans to build smart infrastructure. Therefore, the construction of smart infrastructure is not only to solve the problem of rural population flowing to cities and towns, but also to solve the problem of public products and public services.

2 The Tasks and Goals of China Building New-Type of Urbanization

The first is people-oriented urbanization. More than 10 years ago, the China government put forward the goals and tasks of building new-type urbanization, which emphasizes people-oriented. This type of urbanization supported by city clusters, metropolitan circles, promotes the coordinated development of large, medium and small cities as well as small towns. The so-called people-oriented means that urbanization should focus on urban residents' demand for public products and improve their quality of life, so as to realize urbanization, citizenization, and ultimately realize modernization of people. To achieve this goal, it is necessary to promote the integrated development of city clusters and form a "two horizontal and three vertical" urbanization strategy pattern, including the Beijing-Tianjin-Hebei, Yangtze River Delta, Pearl River Delta, Chengdu-Chongqing, and the middle reaches of the Yangtze River city clusters (Table 1).

The second is construction of modern metropolitan area. Modern metropolitan circle is an urban circle formed by a series of cities with the central city as the core, and the goal is to develop all cities in the metropolitan circle under the drive of the central city. The central city is the city where the provincial government located, and the modern metropolitan circles are centered on provincial cities.

Thirdly, circle of medium-sized cities with county-level small cities as the link to the surrounding small towns (in China, city ranks higher than county). China has 382 county-level cities, which are surrounded by tens of thousands of small and medium-sized towns, and home to more than half of China's population. Because of this, they are the focus of new-type urbanization.

China's new-type urbanization is mainly construct on the basis of spatial layout of the three levels above, requiring that while developing urban circle and metropolitan circles, the development and construction of large, medium and small cities should be guided to form a spatial pattern of urbanization with reasonable density, division of labor and cooperation, and complete functions.

Table 1. City Clusters of China

City Cluster	Contained Cities	Number of City
The Beijing-Tianjin-Hebei City Cluster	Beijing Tianjin Shijiazhuang Qinhuangdao Tangshan Langfang Baoding Cangzhou Zhangjiakou Chengde	2 Municipality & 8 Cities
The Yangtze River Delta City Cluster	Shanghai Nanjing Wuxi Changzhou Suzhou Nantong Yangzhou Zhenjiang Yancheng Taizhou Hangzhou Ningbo Wenzhou Huzhou Jiaxing Shaoxing Jinhua Zhoushan Taizhou Hefei Wuhu Maanshan Tongling Anqing Chuzhou Chizhou Yicheng	1 Municipality & 27 Cities
The Pearl River Delta City Cluster	Guangzhou Shenzhen Zhuhai Huizhou Dongguan Zhaoqing Foshan Zhongshan Jiangmen Hongkong Macao	9 Cities & 2 Special Administrative Region
The Chengdu-Chongqing City Cluster	Chongqing Chengdu Mianyang Yibin Deyang Nanchong Luzhou Dazhou Leshan Neijiang Zigong Meishan Suining Guangan Ziyang Yaan	1 Municipality & 15 Cities
The Middle Yangzi River City Cluster	Wuhan Huangshi Ezhou Huanggang Xiaogan Xianning Xiantao Qianjiang Tianmen Xiangyang Yichang Jingzhou Jingmen Chansha Zhuzhou Xiangtan Yueyang Yizhou Changde Hengyang Loudi Nanchang Jiujiang Jingdezhen Yingtan Xinyu Yichun Pingxiang Shangrao Fuzhou Jian	31 Cities

The Table is Original by Author

3 Literature Review

3.1 The Significance of Smart Infrastructure for the Construction of New-Type Urbanization

The history of human development shows that people flock into cities because they can have opportunity to get better resources and more energy, such as water, land, wind, oil, gas, electricity, solar energy, etc. With the development of urbanization, infrastructure has gradually replaced natural resources as the most important factor attracting people

to move to cities. In addition to essential water and electricity, urban heating and cooling facilities, natural gas, communications, transportation, solid waste treatment, and various building facilities are also indispensable [1]. Transportation is a good example of this. For example, China's high-speed railway brings great convenience to people's travel, and even obviously squeezes the living space of aviation industry. Similar examples also exist in the UK, Germany and other European countries. While transportation infrastructure brings convenience to people's travel, it also greatly speeds up the development of cities [3]. Energy is also a good example for this situation. The boundaries of a city depend on the extent of the energy supply, that is, where the energy can be transported to create a city, but this tests the sustainability of energy supply. To solve this problem, the construction of smart infrastructure that can reuse and recycle energy is a feasible way to improve the efficiency of resource use and speed up urban construction [6].

3.2 How can Smart Infrastructure Provide High-Tech Public Products for Urban Residents

Smart infrastructure is a collection of high-tech infrastructure, mainly including smart transportation infrastructure, smart energy infrastructure, smart environmental protection infrastructure, smart family life infrastructure, smart communication infrastructure, etc. In an era of rapid technology development, these smart infrastructures can upgrade traditional infrastructure with new technologies on the one hand, and provide new public products with new technologies on the other. Through the application of new technologies, traditional infrastructure and smart infrastructure can work together to build smart cities and promote urban modernization [2]. This shows that technological progress is a necessary condition for the construction of smart cities. For the public transportation, logistics, municipal engineering and communication industries, the application of high-tech represented by the Internet, 5G and big data can produce public products with higher technological content for urban residents. For both of government and residents, better public products mean higher efficiency [5].

3.3 Main Problems in the Process of Promoting New-Type Urbanization and Smart Infrastructure Construction in China

There is a positive correlation between the level of technology innovation and the level of smart infrastructure construction in China. Technological innovation can optimize the economic structure, improve economic efficiency, develop emerging industries, regulate the urban environment, and promote the construction of new-type urbanization. The new-type urbanization creates a more suitable environment for urban economic development and opens up space for the application of new technologies. At present, the development of China's new-type urbanization is not balanced. New technologies are concentrated in cities and towns with high economic level, while cities and towns with relatively backward economic level cannot attract new technologies. Therefore, for one thing, the development of new-type urbanization depends on the level of technology innovation, for the other, the level of economic development of cities and towns are the endogenous factor [7]. There are also problems in smart infrastructure development, mainly due to inadequate supporting policies and coordination mechanisms, which are not conducive

to coordinated development. Moreover, the low rate of fiscal self-sufficiency and low participation of social capital in some regions result in insufficient construction funds. For whole urban construction and planning, smart infrastructure tends to crowd out traditional infrastructure, which is detrimental to the overall development of the city [4].

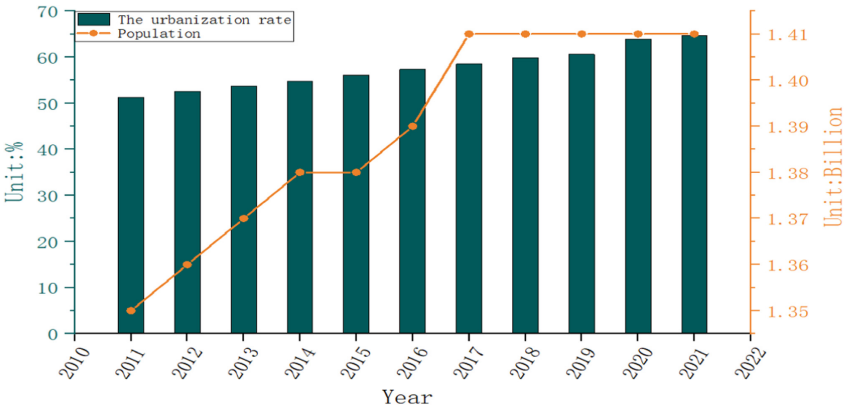
3.4 The Evaluation of Existing Achievements

Existing literature has made a good analysis of the relationship between smart infrastructure and new-type urbanization, and put forward many valuable suggestions, but there is still room for further discussion. First, existing studies have proved that infrastructure is an indispensable material condition for urban development, and high-tech smart infrastructure is a key factor to support urban development as well as improve urban carrying capacity. However, there is a lack of comprehensive and in-depth discussion on how developing countries like China can promote new-type urbanization through building smart infrastructure. Second, in terms of how smart infrastructure serves urban residents by providing high-tech public products, existing literature has well analyzed the application value of artificial intelligence, Internet, 5G, big data and other technologies to the construction of smart infrastructure, however, it is necessary to further study how the technology of smart infrastructure can be applied to the production of public products and how smart infrastructure can improve the quality of public services. Thirdly, the existing research results analyzed a series of problems faced by China's smart infrastructure construction and new-type urbanization construction, these problems do exist and the analysis is also relevant, but more thought needs to be given to how to solve these problems. Fourthly, as China's new infrastructure is still in its infancy, lacking of data is inescapable, and the existing research results have hardly did empirically analysis. This shows that further research on this issue is necessary. Based on the relevant macroeconomic data, this paper tries to do a further research on the above problems from the perspective of the production of new high-tech public products and the supply of new high-tech public services, and puts forward policy suggestions.

4 Construction of New-Type of Urbanization Requires Building Smart Infrastructure

China's new-type urbanization is a multi-level complex urban system. According to this standard of 60% of the population living in urban areas, the urban population should exceed 800 million at this time. In order to support the operation of this huge urban system and provide public products and services to more than 800 million people, it is necessary to build public infrastructure and public service facilities corresponding to it (Fig. 1).

For this purpose, China government put forward the task of smart infrastructure construction, requested the smart infrastructure construction combined with new-type urbanization construction, economic development and urban construction as a whole, public products production and infrastructure construction as a whole. For one thing, it could create material base for the urban's economic development, on the one hand,



The Figure is Original by Author & Data Source: National Bureau of Statistics of China

Fig. 1. 2010–2022 Urbanization Rate and Population

it could provide high quality public products for urban residents. Smart infrastructure is relative to the traditional infrastructures such as railways, highways, airports, its essence is the modern information technology, artificial intelligence, Internet, 5g, big data used in infrastructure construction. At the same time, traditional infrastructure could be transformed. Smart infrastructure main include information infrastructure, convergence infrastructure and innovation infrastructure.

At present, China faced with the important task of building a complete industrial chain and supply chain, and the construction of new industrial chain and supply chain must be based on smart infrastructure. Therefore, the construction of infrastructure serves economic development and improves the quality of industrialization. Most of China's manufacturing, household appliances and financial services industries are concentrated in urban agglomerations and metropolitan areas, while some are scattered in small and medium-sized cities. Similarly, China's domestic market and the main markets connecting the international market are also concentrated in cities (Table 2).

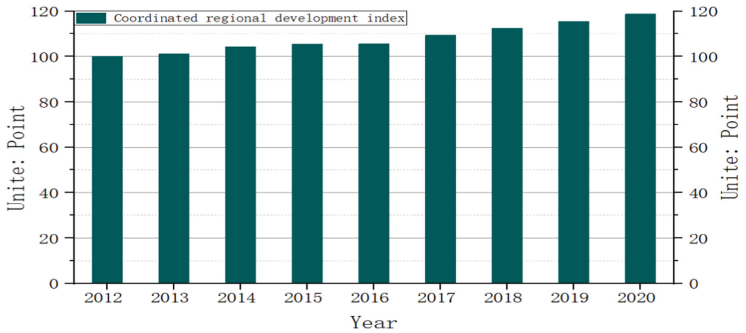
To build a new industrial chain and supply chain, as well as build a unified domestic market and smooth international market, China must connect city clusters, metropolitan areas and small cities, as a result, a complete industrial production system and a unified domestic market could be constructed. This huge modern industrial system and modern market system has never appeared in China's history, and there are only a handful of them in the world today. Therefore, perfect infrastructure system is needed to provide support.

A huge urban system with huge population needs a huge amount of high level public infrastructure to provide support. From practical point of view, the original public infrastructure can no longer meet this huge demand in both quantity and quality, thus it is necessary to build smart infrastructure. As the basic public services and transportation infrastructure is the main indicator of regional economic development, there is still a gap between China and developed countries in terms of regional economic development (Fig. 2).

Table 2. 2022 Modern Public Service Development Index

Category	Weight	2021 (Unite: %)	2022 (Unite: %)	Increase or Decrease of 2022 (Unite: Percent Point)
Technology	9	61.9	63.1	1.2
Public Security	9	85.6	86.3	0.7
Entertainment	9	60.8	62.4	1.6
Public Administration	10	61.2	62.0	0.8
Municipal Construction and Environmental Protection	11	61.4	62.3	0.9
Social Security	13	62.6	63.5	0.9
Employment Service	13	62.5	63.4	0.9
Education	13	60.8	62.0	1.2
Medical Treatment and Public Health	13	62.9	63.7	0.8
Modern Public Service	100	64.0	65.0	1.0

The Table is Original by Author & Data Source: 2022 China's Modern Public Service Development Index 65.0: Safety Leading and Cultural Service "Big Stride". Insight China.



The Figure is Original by Author & Data Source: China Coordinated Regional Development Index Report (2020)

Fig. 2. 2012–2020 Coordinated Regional Development Index

In this sense, the construction of smart infrastructure is required for the construction of new-type urbanization, also required for the improvement of quantity and quality of public products as well as the level of public services. Just because of these, China government has stressed the necessity to combine smart infrastructure with new-type urbanization, combine economic development with the production of public products and supply of public services in a coordinated manner.

5 Providing Urban Residents with High-Tech Public Products Through the Construction of Smart Infrastructure

5.1 Providing High-Tech Level Public Information Products Through the Construction of New Information Infrastructure

One of the tasks of China's new-type urbanization construction is to produce information products based on the model of "Internet + public service". This model is to combine Internet with public service facilities, build a smart city based on Internet and carried by information facilities, and provide public information services to residents. First, put communication systems and Internet into public infrastructure development plans, make informatization and intelligent improvements to water, electricity and gas pipelines and other public facilities. Second, combine digital technology with Internet to build digital towns. Third, information-based and digital services should be provided in education, medical care, elderly care, childcare and employment (Table 3).

To this end, China government has put forward the requirements for the secure and efficient information infrastructure, emphasizing the acceleration of network infrastructure construction projects in small and medium-sized cities, so as to promote the interconnection between large, medium and small cities, and also between towns and villages, build an integrated information network in cities and towns. In this way, convenience of information services could be ensured.

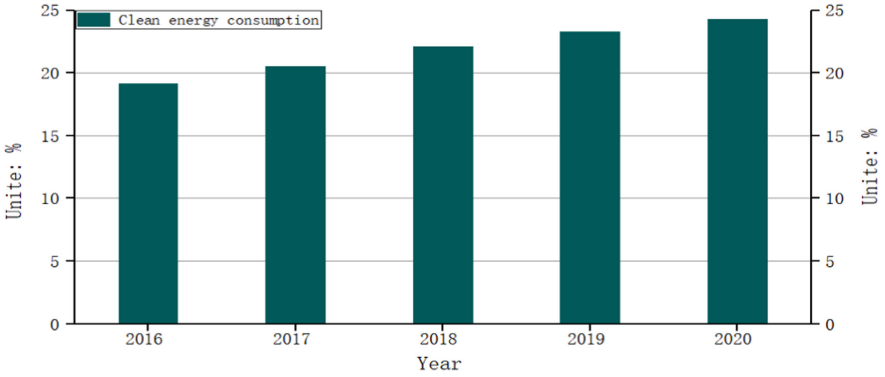
5.2 Providing High-Tech Public Products Such as Public Transport, Public Health and Telemedicine Through the Construction of New Integrated Infrastructure

The role of the new integrated infrastructure lies in improving the function of urban traffic facilities and realizing traffic informatization and intelligentization. In according

Table 3. Top 10 of Provincial Information Infrastructure Development Index in 2017

Rank	Provinces	Point of Information Infrastructure
1	Beijing	13.65
2	Zhejiang	13.39
3	Jiangsu	12.77
4	Shanghai	12.14
5	Guangdong	11.74
6	Fujian	11.23
7	Tianjin	11.10
8	Hubei	11.04
9	Liaoning	11.02
10	Chongqing	10.90

The Table is Original by Author & Data source: Cyberspace Administration of China



The Figure is Original by Author & Data Source: National Bureau of Statistics of China

Fig. 3. 2016–2020 the Proportion of Clean Energy Consumption in Total Energy Consumption

to this, China government calls for accelerating the construction of integrated infrastructure, realizing the integration of urban agglomeration and intercity transportation, and extending urban transportation to rural areas to realize the integrate transportation of urban and rural. In addition, the construction of new medical and health facilities should be combined with the needs of urban public health and telemedicine to ensure the health of residents. Based on these needs, China has set the task of integrated infrastructure construction (Fig. 3).

First, develop regional airports, general airports and cargo airports in a coordinated manner, develop general aviation and establish a whole air transport system.

The second is to speed up the construction of intercity railway (railway between cities), urban and suburban railway and urban rail transit, forming railway, highway and urban road integration of transport network facilities (Table 4).

Third, artificial intelligence, 5G networks and other technologies will be used in public health and telemedicine to build new medical and health facilities. The above three aspects are important contents of the construction of new-type urbanization with smart infrastructure services, as well as public products urgently needed by urban residents.

5.3 Providing High-Tech Public Service Products Through the Construction of Innovative Infrastructure

Innovation infrastructure actually refers to the facilities for scientific research and technological development, consisting of scientific research platforms such as large scientific installations and national laboratories. Most of these facilities are funded by the state and co-built by research institutions, universities and enterprises, so they are quasi-public products. Most of China's research institutes, universities and high-tech enterprises are located in cities, and their research infrastructure is also built in cities (Table 5).

Therefore, building innovative infrastructure and providing high-quality scientific and technological public service products is also one of the tasks of new-type urbanization.

Table 4. Top 10 of Traffic Congestion Index of Cities in 2021

Rank	Cities	Traffic Congestion Index
1	Beijing	2.048
2	Chongqing	2.006
3	Changchun	1.956
4	Guiyang	1.935
5	Shanghai	1.877
6	Guangzhou	1.776
7	Wuhan	1.772
8	Harbin	1.741
9	Kunming	1.741
10	Xian	1.736

The Table is Original by Author & Data Source: Traffic Analysis Report of Main Cities of China in 2021, AutoNavi

Table 5. Top 10 Science and Technology Innovation Development of Cities in 2020

Rank	Provinces	Point of Information Infrastructure
1	Beijing	0.7014
2	Shenzhen	0.5712
3	Shanghai	0.5577
4	Guangzhou	0.5079
5	Nanjing	0.5066
6	Hangzhou	0.4934
7	Suzhou	0.4397
8	Wuhan	0.4338
9	Xian	0.4257
10	Zhuhai	0.4204

The Table is Original by Author & Data Source: Report on Science and Technology Innovation Development in China Cities 2020

China's urbanization is designed to serve the majority of the population, the same goes for smart infrastructure. Therefore, both new-type urbanization and smart infrastructure construction should focus on the production of public products and be organized around public services.

6 The Problems of Coordinate the Development of New-Type Urbanization and Smart Infrastructure

China is a vast country with a long history of urban development. There are ancient cities formed naturally by agricultural society, modern cities formed by the promotion of commodity economy, and postmodern cities newly built after the reform and opening up. Due to the urban-rural dual structure, the distribution of industry and population is not balanced. Megacities and large cities are concentrated in the central and eastern regions, coastal areas, the Yangtze River and Yellow River basins, while the areas with agriculture as the main industry are concentrated in smaller cities and towns. The urban-rural dual structure and the unbalanced development of cities and towns restrict China's economic development and economic structural adjustment to a large extent, so it is necessary to coordinate urbanization construction. On the other hand, infrastructure mainly serves large and medium-sized cities, resulting in unequal public services. Due to these reasons, new-type urbanization and smart infrastructure construction are faced with the following problems:

6.1 Coordination of Spatial Layout of Smart Infrastructure and Layout of New Towns

Most of China's urban layout is naturally formed with the distribution of industry, commercial layout and people's migration. Towns with a long history lack scientific planning and their spatial structure is not reasonable. Therefore, China government put forward the requirements of improving the spatial layout of urbanization and made specific plans. The first is to promote the integrated development of city clusters, form multi-center and multi-level network model city clusters. Second, based on the central cities, radiate to the surrounding cities to build modern metropolitan circles. The third is to promote the urban-rural integration construction by taking county and towns as the carrier. However, to improve the spatial layout, smart infrastructure is necessary. Due to various reasons, smart infrastructure lags behind urban construction, resulting in the mismatch between infrastructure construction and urbanization construction, and the layout of infrastructure construction does not adapt to the layout of urbanization. Therefore, it is necessary to optimize the layout of infrastructure according to the spatial layout of cities and towns.

6.2 The Imbalanced and Immature Technology for the Smart Infrastructure has Restricted the Construction of New-Type Urbanization

Building smart infrastructure requires the support of information technology, digital technology, artificial intelligence and other technologies. Some of these new and high technologies have reached a high level, some are relatively backward, and some are still in the research stage. Research on these new and high technologies requires perfect innovation infrastructure and high-level scientific and technological talents, which is also relatively lacking. In particular, the subjects of scientific and technological innovation in China include state-owned enterprises, private enterprises, scientific research institutions and universities. How to organize different subjects for joint research is not only a problem in the face of the construction of smart infrastructure, but also a problem in the face of the construction of new-type urbanization.

6.3 How to Integrate the Production of Public Products with the Development of Smart Infrastructure and New-Type Urbanization

The smart infrastructure and new-type urbanization serves the life and work of urban residents. Therefore, it is necessary to integrate the production of public products into the process of smart infrastructure construction and new-type urbanization construction to truly make people-oriented. The production of public products is in principle consistent with urban construction and infrastructure construction. However, serving economic development is also an important goal of urban construction and infrastructure construction, part of the infrastructure may be more conducive to economic development and become a priority project, while part of the infrastructure may be more conducive to public services but take up resources for economic development. Therefore, how to combine the production of public products with economic development, reasonably arrange urban construction and infrastructure construction projects, need to make reasonable and systematic institutional arrangements.

7 Suggestion

Based on the above analysis, this paper can get some conclusions and put forward some suggestions as below:

First, China government should do a good job in top-level design, combine smart infrastructure construction plans with new-type urbanization construction plans, and make overall arrangements.

Second, combine the production of public products, supply of public services and economic construction to produce high-tech public products and provide high-tech public services for residents while building new-type urbanization and smart infrastructure.

Third, smart infrastructure and new-type urbanization should be well distributed and a new pattern of urbanization should be established. Some large-scale projects involve different regions, different provinces and county-level cities, thus the leading role of the government should be played to break the boundaries of administrative divisions and optimize the layout of projects.

Fourth, the government should play a leading role in guiding scientific research institutions, enterprises, universities and other innovation subjects to carry out technological innovation around the construction of smart infrastructure and new-type urbanization, provide technical support for the construction of new-type urbanization and smart infrastructure, and produce high-tech public products at the same time.

8 Conclusion

First, as a developing country, it is a feasible path for China to promote new-type urbanization by building smart infrastructure, and also a reasonable choice during the period of new technological revolution and new industrial revolution. The development path of developing countries is similar to that of China, so the new-type urbanization path chosen by China can provide experience for developing countries. The problems in face

of China's new-type urbanization are also those in face of other developing countries. Joint exploration by China and other developing countries will help overcome these problems.

Second, the process of building smart infrastructure is also the process of producing high-tech public products and providing high-tech public services. Therefore, it is necessary to make overall arrangements for the construction of smart infrastructure, construction of new-type urbanization and production of high-tech public products, which developing countries can draw lessons.

Third, construction of smart infrastructure and the layout of new-type urbanization should be people-centered and people-oriented. While providing public services, conditions for people's development should be created. This is the main difference between new-type urbanization and traditional urbanization. Urbanization break away from people will inevitably lead to public service inequality, and to solve the problem of public service inequality needs to pay a high price. This is a lesson from the process of urbanization development in China, and learning this lesson is conducive to making good institutional and policy arrangements for urbanization construction in development.

References

1. Derrible S (2019) An approach to designing sustainable urban infrastructure. MRS Energy Sustain Rev J 5:E15
2. Dorofeeva L, Rodionov D, Velichenkova D (2019) Infrastructure potential of creating "Smart Cities". In SPBPU IDE 2019: Proceedings of Peter the Great St. Petersburg Polytechnic University international scientific conference on innovations in digital economy, Saint-Petersburg, pp 1–7
3. Mitchell D, Claris S, Edge D (2016) Human-centered mobility: a new approach to designing and improving our urban transport infrastructure. Engineering 2:33–36
4. Shi Y (2020) Main characteristics, scale measurement and influence factor analysis of new infrastruction. Mod Finance Guide 7:21–25
5. Stepniak C, Jelonek D, Wyrwicka M, Chomiak-Orsa I (2021) Integration of the infrastructure of systems used in Smart Cities for the planning of transport and communication systems in cities. Energies 14(11):3069
6. Taminiau J, Byrne J, Kim J, Kim M, Seo J (2021) Infrastructure-scale sustainable energy planning in the cityscape: transforming urban energy metabolism in East Asia. WIREs Energy Environ 10(5):E397
7. Tian YP, Guo JQ, Liao WK (2021) The effect of innovation driving on high-quality development of new-type urbanization. Contemp Econ 3:22–27