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Perspective on Study of Urban Science

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Perspective on Study of Urban Science

Abstract

Improving the urbanization strategy and making the city a space for the people's high-quality life is the new requirement put forward by General Secretary Xi Jinping for urban development. To fulfill this requirement, it is needed to study and understand in-depth consideration of urban development issues. This work studies urban issues from the national conditions such as urban morphology, population distribution, population mobility, and flow of peasant workers. Focusing on the overall requirement of respecting regularity, this study considers the connotation of urbanization and socialist modernized cities in the era of ecological civilization. Reviewing the theoretical basis of urban science proposed by Qian Xuesen, this study puts forward the guiding principles for the current research on urban science, and the main points and contents for thinking based on a new stage, implementing new ideas, and constructing a new pattern.

Keywords

urbanization strategy, urban science, balanced urban and rural development, common prosperity, urban transportation

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Perspective on Study of Urban Science

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Abstract: Improving the urbanization strategy and making the city a space for the people's high-quality life is the new requirement put forward by General Secretary Xi Jinping for urban development. To fulfill this requirement, it is needed to study and understand in-depth consideration of urban development issues. This work studies urban issues from the national conditions such as urban morphology, population distribution, population movement, and flow of migrant workers. Focusing on the overall requirement of following regularity, this study considers the connotation of urbanization and socialist modernized cities in the era of ecological civilization. Reviewing the theoretical basis of urban science proposed by Qian Xuesen, this study puts forward the guiding principles for the current research of urban science, and the main points and contents for thinking based on a new stage, implementing new ideas, and constructing a new pattern. **DOI:** 10.16418/j.issn.1000-3045.20211126001-en

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With the development of information technology, the research of urban science has become a global hotspot for both researchers and policy-makers. At the early stage of urbanization in China in the 1980s, Qian et al. [1] proposed to employ open complex giant system theory to study the complex urban issue and emphasized the guidance by Marxist philosophy. Since the 18th National Congress of the Communist Party of China, General Secretary Xi Jinping has delivered speeches on urbanization and urban issues at the 2013 Central Working Conference of Urbanization and the 2015 Central Urban Work Conference. In 2020, General Secretary Xi Jinping proposed to improve the urbanization strategy in the Major Issues Concerning China's Strategies for Mid-to-Long-Term Economic and Social Development. Guided by Xi Jinping's thought on socialism with Chinese characteristics in the new era and focusing on the requirements of the Outline of the 14th Five-Year Plan for Economic and Social Development (2021–2025) and Long-Range Objectives through the Year 2035 of the People's Republic of China, we should understand the urban issues raised by Qian Xuesen, and think about the guiding principles of today's urban science following the rules of urbanization and urban development. We should explore the future of city with scientific perspectives and methods when building modern socialist cities in China.

1 Characteristics and practices of urbanization in China at present

1.1 Connotation and requirements of urbanization

(1) Reflections on the term urbanization. Urban is a core issue in the general trend of world development. Many terms such as urban-rural integration are derived from urbanization, which is the process of people shifting from rural to urban areas on a large scale, or the process of continuous development and improvement of cities. Essentially, it is the transformation of human lifestyle and production modes from the agricultural society to the industrial society, which is manifested as the increasing social and economic activities and the significantly improved social civilization. Therefore, urbanization is not a result of social development, but an essential stage in the social development. The study of urbanization requires a deep understanding of the mechanism of urban development, which is an important issue directly related to national economic and social development.

(2) The importance of urban society. City is the physical form and social organization of human civilization and a space for the activities associated with the economic foundation and superstructure. Regardless of its location, a city is the center of local economic, political, cultural, and social activities. At the national level, urban development plays a global, strategic, and persistent role in driving economic and

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social development, especially in pivotal urbanized areas. Therefore, urbanization is the basic positioning of urban work.

(3) New requirements of the central government for urban development. Strategic thinking and deployment should be carried out for the urbanization and urban development in China. The 2013 Central Working Conference of Urbanization proposed that the promotion of urbanization must take into consideration of the basic national conditions at the primary stage of socialism in China. It is necessary to be people-oriented and promote people-centered urbanization. We should optimize and construct a scientific and rational layout of urbanization according to the capacity of resources and environment. Urban agglomeration should be used as the primary form of urbanization for the reasonable function division, function complementation, and coordinated development of large, medium, and small cities and towns. Urban development is a systematic project. The 2015 Central Urban Work Conference proposed to follow the regularity of urban development and improve the leadership of the Chinese Communist Party in the urban work.

1.2 Current status of research on urban issues

(1) Urban morphology. The current urban hierarchy in China is still dominated by central cities while metropolitan areas are developing. This process embodies the two trends of population concentration to urban build-up areas and city-driven rural construction. From the constitutional point of view, China's administrative system is the overall planning of urban and rural areas. In super- and mega-cities, the build-up area account for 3.5%–55% (usually <50%)^①, which is a basic feature of cities in China. With the integrated economic and social development of urban and rural areas, China has established a municipal system with more content than that in the 1980s. With the improvement and differentiation

of urban information flow and network, urbanized areas have evolved from points to lines and polygons (Figure 1). The urbanization has shifted from agglomeration to radiation, with the formation of urban agglomeration and metropolitan areas which have closer economic and social relationships between administrative cities^[2,3]. This urban system is a unique characteristic in the development of Chinese cities, which is different from that of other countries.

(2) Characteristics of urbanization at a new stage. In 2020, the urbanization rate of resident population reached 63.9% in China^②. According to the general trend of urbanization in the world, China is still embracing the rapid urbanization rate of 30%–70%. However, with the profound changes in the internal and external environment, urbanization in China has entered a stage of transformation focusing on high-quality development. This is embodied in the enhancement of the radiation of central cities to the surrounding areas, forming a spatial dynamic system in which the metropolitan area leads the urban agglomeration and the urban agglomeration drives the high-quality development of the region. To meet the goal in both economy scale and ecological health, the municipal system places more emphasis on the reasonable development of suburban and satellite cities around central urban areas, and the promotion of multi-centered clustering development to achieve industry–city integration and work–residence balance. For super- and mega-cities with mature urbanization, more attention should be paid to the new trend of building a high-quality living space that is livable, innovative, intelligent, green, humanistic, and resilient. County has been recognized as the basic unit of urban-rural integration, which is also an important carrier for realizing the free flow of urban and rural elements and the rational allocation of public resources in the future city development.

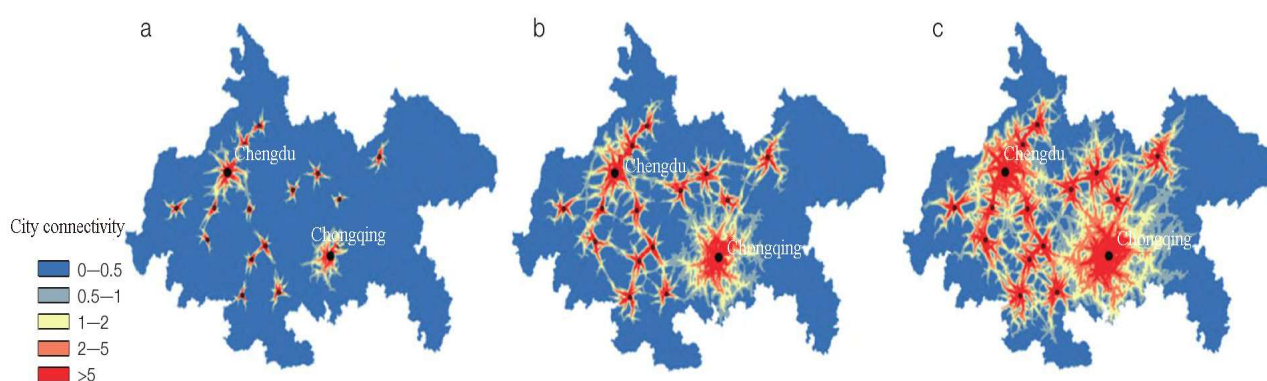


Figure 1 Changes of urban field strength in Chengdu-Chongqing area (transportation)⁽³⁾

(a) 2002; (b) 2010; (c) 2018

① Except Shenzhen where the proportion of build-up areas reached 55%, the proportions in all other cities were less than 50%.

② Interpretation of the Seventh National Population Census Bulletin. http://www.stats.gov.cn/tjsj/sjjd/202105/t20210512_1817336.html.

(3) Population mobility. At present, China's population mainly clusters in central urban areas and counties, with differentiation between cities (Figure 2). According to the data of the Seventh National Population Census of China, the population growth rate has declined, with an average value of 0.53% from 2010 to 2020, which decreased by 0.04 percentage point compared with that (0.57%) from 2000 to 2010. The size of floating population^③ increased significantly, with nearly 380 million people, and there were nearly 500 million people with separated registered and actual residences. In terms of floating direction, the population mainly concentrated in eastern China. The proportion of population in western China slightly increased, and the northeast and central regions were characterized by a significant outflow. At the provincial level, the floating population within provinces was 251 million, which increased by 115 million (85.16%) compared with that in 2010. The floating population across provinces was 125 million, which increased by 39 million (45.37%) compared with that in 2010. The within-province floating population is growing faster than the cross-province floating population, and the latter is mainly distributed in the eastern coastal provinces and in Xinjiang.

At the city level, the population mainly flowed to central cities such as municipalities directly under the central government, provincial capital cities, and cities with separate national economic and social development planning. At the county level, the population flowed to the town where the county government is located, which reflects the basic pattern of population movement to areas with sound economic development. In terms of the composition, migrant workers still dominate the floating population. According to the data of the Seventh National Population Census of China, the growth rate of population flow between cities and towns exceeded that of migrant workers in the past 10 years (Figure 3), and the scale of population flow between cities has gradually expanded. Population movement in China is an important issue to be studied, and the trend of which is a perspective to understand the policies of the central government and to study city layout. How to study the relationships between urbanization, rural revitalization strategy, and regional development strategy is a question that must be answered. Moreover, the implementation of strategies in the future is directly related to the allocation of public resources and the layout of public service facilities.

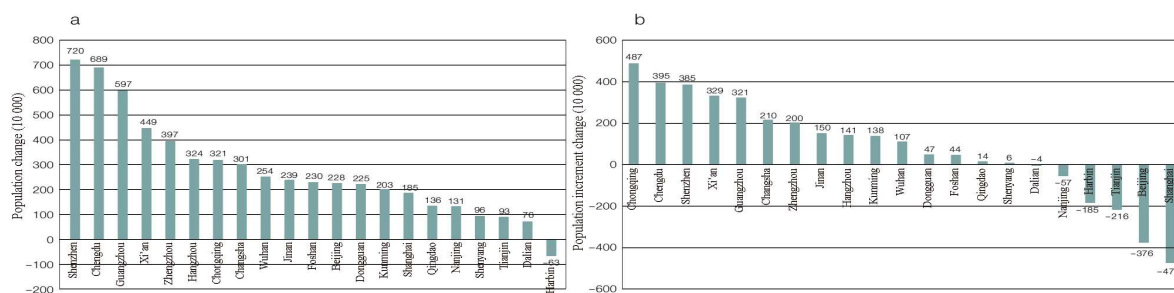


Figure 2 Population change in China's mega cities

(a) Population change in China's mega cities between 2010 and 2020; (b) Population increment change in China's mega cities between 2010–2020 and 2000–2010

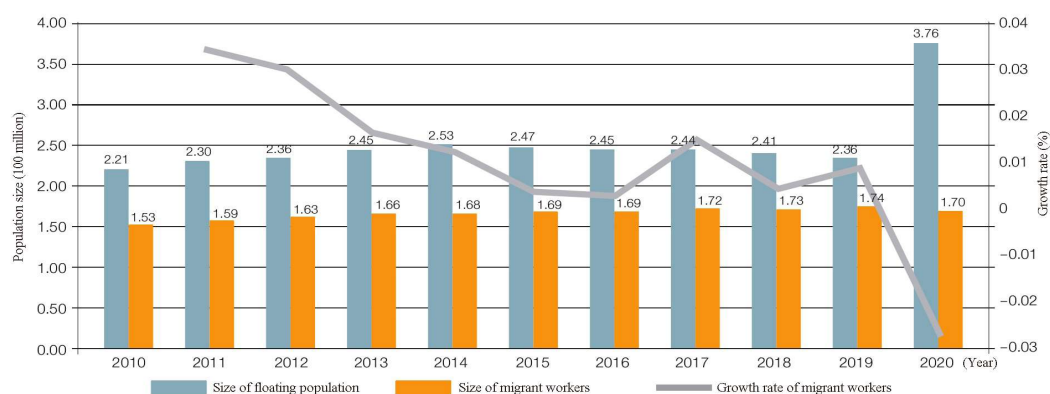


Figure 3 Comparison of scale of China's migrant population and migrant workers from 2010 to 2020

Data source: The Leading Group of the State Council for the Seventh National Population Census, Commissioner of the National Bureau of Statistics of China (http://www.gov.cn/guoqing/2021-05/13/content_5606149.htm)

③ The floating population in this paper is not necessarily migrant workers, while migrant workers are included in the floating population.

(4) Flow of migrant workers. The total number and growth rate of China's migrant workers decreased from 2011 to 2020 ⁽⁴⁾ (Figure 4). Eastern China still showed net input of migrant workers but decreasing number of migrant workers, and the number of migrant workers significantly increased in the central and western regions (Table 1). The education background of migrant workers has been increasing, and their living space per capita in the city, living facilities, and other indicators have been improved continuously. Meanwhile, the education of accompanying children has improved as manifested by the increasing school attendance and reducing difficulty in attending school. These are the basic requirements for migrant workers to become city residents, and they also represent a core content of common prosperity. According to

the census data ⁽⁴⁾, the average age of migrant workers has increased from 36 to 42 years old. The increasing age of migrant workers needs to be intensively studied for the urbanization in China.

Overall, given the characteristics of urbanization in the new era, the requirements and opportunities of urbanization in China have changed. (1) We should promote people-centered urbanization, and make cities healthier, safer, and more livable spaces for people to live a high-quality life ⁽⁵⁾, which can be combined with the goal of common prosperity. It should be noted that the common prosperity of new urbanization is neither the equalization of wealth nor the simple relief of the poor, but the cultivation of a new social structure. (2) People-centered urbanization is not only reflected

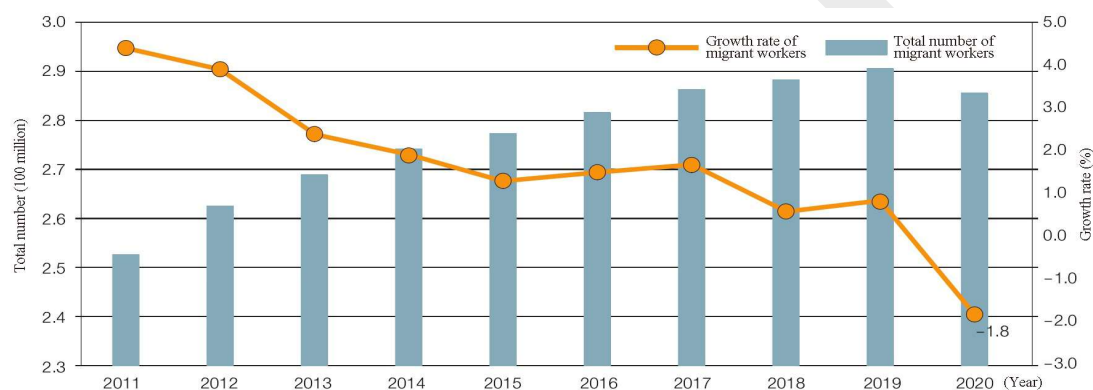


Figure 4 Total number and growth rate of China's migrant workers from 2011 to 2020

Table 1 Output and growth rate of migrant workers in regions from 2019 to 2020

	Input of migrant workers (10 000)		Input of migrant workers (10 000)	Growth rate of migrant workers (%)
	2019	2020		
By regions of output				
Eastern China	10 416	10 124	−292	−2.8
Central China	9 619	9 447	−172	−1.8
Western China	8 051	8 034	−17	−0.2
Northeastern China	991	955	−36	−3.6
By regions of input				
Eastern China	15 700	15 132	−568	−3.6
Central China	6 223	6 227	4	0.1
Western China	6 173	6 279	106	1.7
Northeastern China	895	853	−42	−4.7
Other regions	86	69	−17	−19.8

* Including China's Hong Kong, Macao, and Taiwan, and abroad

⁽⁴⁾ National Bureau of Statistics. National Reports on Migrant Worker Monitoring and Survey 2011–2020. <http://www.stats.gov.cn/tjsj/zxfb/>.

⁽⁵⁾ To better promote people-centered urbanization. http://www.xinhuanet.com/comments/2020-11/26/c_1126787126.htm.

in the expansion of space and changes in human activities but also in the systemic thinking, which should be combined with scientific thinking (seven thinking: strategic thinking, bottom line thinking, systematic thinking, dialectical thinking, innovative thinking, legal thinking, and people-oriented thinking). (3) With the implementation of the proposals at the Central Urban Work Conference, we should follow the rules of urban development to improve urban governance system and capacity and solve the problems such as “urban diseases” according to local conditions. (4) Emphasis should be placed on the role of information technology development and the informatization in the four dimensions of cognition, data, algorithm, and computing power for the construction of intelligent cities.

2 Background and principles for urban science

2.1 Background: the research on urban science advocated by Qian Xuesen

The urbanization in China accelerated in the 1980s. Qian Xuesen ^[4] promptly proposed to carry out research of urban science, and emphasized the planning of urban construction and the establishment of urban science, highlighting the importance of overall consideration. City is a big system, and it is impossible to work without a systematic and holistic consideration. Urban science is different from urban planning, land engineering, water engineering, and other engineering which study the transformation of the objective world. It is unlike the basic sciences of political economy and geography. Instead, it is an applied theoretical science of both, which is somewhere in the middle of theoretical science and engineering. The research of urban science requires (1) the guidance by Marxist philosophy and (2) the use of a systems science perspective and methodology ^[4]. Therefore, we need strategic vision, scientific thinking, and pragmatic spirit when thinking about specific urban issues in the national urban pattern.

Michael Batty ^[5], a representative scholar of Urban Science, pointed out that understanding cities is not just about the urban space but also how flows and networks shape cities. On the basis of complex science, the connotation of regional science and urban economics in urban science was systematically collated, which was referred to as new science of cities by Michael Batty ^[5]. In the new era, China’s urban science should aim at building socialist modern cities. Under the guidance of Marxist philosophy, the systematic thought and information technologies of urban science should be used to systematically solve urban problems with proper methods. The thinking of system theory in urban science echoes with the urbanization strategy and the seven thinking methods ^[6] proposed by General Secretary Xi Jinping, which provides

ideas for studying the current urban development issues with the support of information technology.

2.2 Principles for the research of urban science

(1) To reflect the characteristics of current times. The world is experiencing profound changes unseen in a century. With rapid economic development, China has become a key emerging market for global investment, which has profoundly impacted the global political and economic patterns. As urbanization enters the middle and late stages, China insists on promoting the new urbanization with scientific and technological innovation, and an increasing number of cities have participated in international urban competition. China’s cities and urban agglomerations are changing the global urban pattern (Figure 5). The reform and adjustment of global governance system is profoundly impacting the development of humanity. China has built a moderately prosperous society in all aspects and entered a new stage of building a great modern socialist country. The total economic output associated with urban development, urban development pattern, urban influence, and urban governance modernization suggest the research of urban science to focus on the requirements proposed by the central government for cities and urbanization after the 18th National Congress of the Communist Party of China.

(2) To implement Xi Jinping’s thought of socialism with Chinese characteristics in the new era. In the post-COVID-19 era, the research of urban science should implement Xi Jinping’s thought of socialism with Chinese characteristics in the new era and understand the characteristics of intercity flow of population in China. Such research will help to solve the problem of migrant workers during settling in cities and promote rational allocation of population factors to further achieve common prosperity in urban and rural areas. The improvement of urbanization strategy requires exploring the future of cities with scientific visions or methods. Cities, metropolitan areas, and urban agglomerations should be built in accordance with the principles of urban development.

3 Urban science: new ideas of urbanization and modernization

3.1 Thinking about urban science in the new era with new concept and new pattern

(1) Urbanization is the only way to modernization. The gathering of people to cities is an inevitable trend in national modernization, and the process of urbanization drives rural changes. Urban society is the carrier of technological progress and industrialization, and the central cities and urban agglomerations with international competitiveness are the core of national modernization. Building cities suitable for living and working with the harmony between human and nature is the connotation of modernization. The process of modernization necessarily involves the use of natural

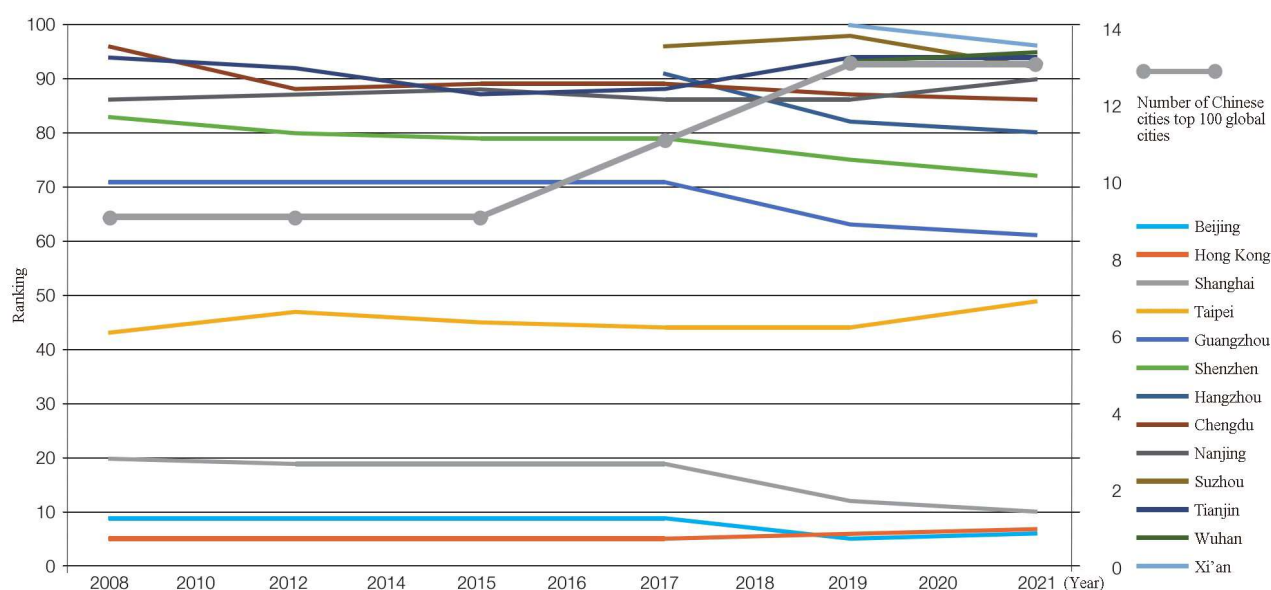


Figure 5 The ranking and number of Chinese cities in top 100 global cities in 2008–2011

Data source: 2021 Global cities report: Global cities: Divergent prospects and new imperatives in global recovery

resources. Efforts should be made to reduce the interference with the self-restoration of the natural environment and prevent damage to the natural environment.

(2) The process of urbanization in China differs from that in developed countries, transforming from industrial civilization to the era of ecological civilization. From a global perspective, the urban economic development in China has a promising prospect. However, the vulnerability and uncertainty of the natural and social environment in cities under global climate change is the hot topic of the current urban research. China is in the zone sensitive to global climate change, and the warming in China is more rapid than the global mean level [7]. Cities in China cannot take the urbanization road of industrial civilization, which is characterized by pollution followed by treatment. Instead, we should take the road of building modern cities with Chinese characteristics by promoting rural revitalization while realizing ecological civilization. At present, China is still in the process of urbanization. In view of the risks faced or possibly faced by different regions, regional risk management mechanisms should be used to enhance urban resilience.

(3) The development of information technology not only transforms our way of thinking and lifestyle but also improves the efficiency of resource utilization and the ability of ecological protection. China has become one of the leading counties in information technology, and its innovation capability is in a parallel or even leading position as compared with American and European countries. After the outbreak of COVID-19, movement tracking with big data has become an effective tool for the pandemic prevention and control. Meanwhile, the lifestyle has changed as manifested by the shifting of urban transportation from a traditional transportation

network to a coupled-network development model, of resident daily supply from offline to a combination of online and community service model, and the daily work from a regular on-site mode to flexible work arrangement. Smart city is a new paradigm for urban development, with an all-round improvement in resource utilization efficiency and ecological protection, as well as an increase in the sense of well-being and the sense of gain of urban residents [8].

(4) We should take a road of building modern cities with Chinese characteristics, promote the implementation of the strategy for rural revitalization, and improve the level of new urbanization. Increasing the urbanization rate is a quantitative expression of the social development stage, which is essential to achieve the common prosperity in urban and rural areas and is the fundamental goal of social development [9]. The overall planning of urban and rural areas is a systematic work, and through the comprehensive guidance of public policies in many fields, we should optimize social and economic elements between urban and rural areas to realize the harmonious development of urban and rural areas. It is a dynamic work with different focuses in different periods and different cities, and should be realized at different stages and levels, which requires specific policies targeting the development stage and city location.

(5) We should establish a sound urban ecosystem and safety system for urban residents to live in a high-quality living space. Urban planning should be adjusted to promote high-quality economic growth and build high-quality urban ecosystem and safety system. In the face of ecological problems across administrative regions, collaborative planning and governance by local governments should be adopted. Within administrative regions, the scale of city development

should be controlled within environmental capacity to achieve multi-scale ecosystem protection [2].

3.2 Research content and methods of urban science

(1) City is a manifestation of the progress of social civilization. By 2035, more than 70% of Chinese population is expected to live in cities [10]. In the new era, cities are growing not only in size but also in complexity. The global ranking of Chinese cities continues to rise (Figure 5), which has led to the formation of urban agglomerations such as Beijing-Tianjin-Hebei region, the Yangtze River Delta, and Guangdong-Hong Kong-Macau Greater Bay Area with cross-administrative resource allocation. As a complete and indivisible system, a city should be studied with the thinking of system theory. Urban science involves both natural sciences and social sciences. This means that the study of urban issues involves human activities in urban society and requires a new perspective of thinking.

(2) The basic principle of the existence and development of a city is the communication and cooperation between people living in the city. A city is not only a collection of space units but also a complex interconnection between different spaces. Unlike the spatial thinking in traditional urban planning, a city not only involves simple spatial relationship but also the relationship of people moving in the space. Therefore, it is necessary to think about city issues in a complete network system. In the information age, data has become a key factor of production, therefore enabling the research of urban science in the temporal dimension. The research of urban science in the era of big data requires researchers and planners to make a change in thinking from spatial dimension to spatial dimension + temporal dimension [5]. Urban science should adapt to this concept and study why people live in urban agglomerations and how they socialize with each other. Additionally, it is necessary to study energy supply, urban transportation, residential environment, and environmental impact.

(3) The unpredictability of urban development is becoming increasingly apparent. A new round of scientific and technical revolution and industrial revolution is rising worldwide, and new technologies have been applied in multiple scenarios of cities. This has changed the paradigm of urban development and is the basic issue in the current urban research. The digital technologies will alter the traditional perceptions of space and distance, and may facilitate a shift in the target of population movement from a few large cities to many small and medium-sized cities. This increases the unpredictability of urban development and therefore requires careful consideration in the study of the patterns and problems of urban development.

(4) People concern and plan the future of cities. Planning the city of the future has been based on broad architectural and social management theories for more than a century. There is a significant gap between the stability of urban

physical space and the rapid change of people's behaviors. Urban planning is insufficient to deal with the unpredictability of current urban development if it only studies the physical state of city. Space is the slow variable while human behavior is a fast variable. In the stage of high-quality development with stock enhancement, the slow variable is the increase in the actual utilization efficiency of the stock, and the fast variable is the demand for the momentum of urban development. The study of urban science should use the thinking and methods of systematic theory and multiple disciplines to regard cities as the needs of human activities in the material network (Figure 6).

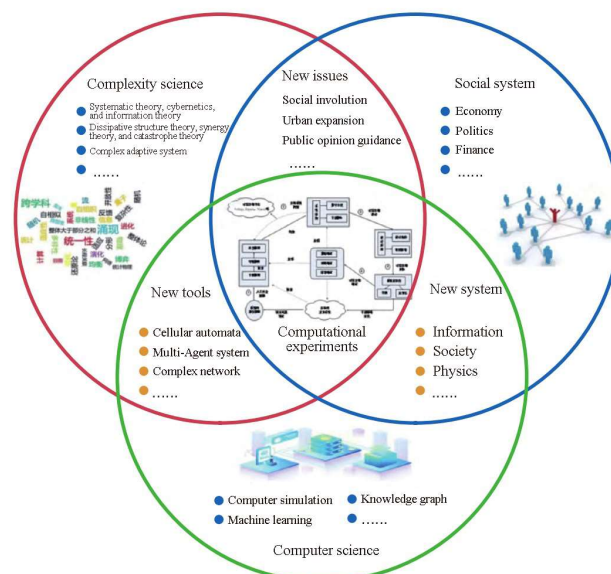


Figure 6 Social science approaches to urban problems

(5) The development of informatization technology and digital economy has become the general trend of economic and social development. In 2019, the added value of digital economy in China reached CNY 35.8 trillion, contributing 67.7% to the growth of GDP (Figure 7). Meanwhile, there are more than 400 000 industrial Internet service companies [12]. Urban research and planning should use information analysis technology to promote the construction of digital city in an orderly manner, thus achieving the equalization of public services. Informatization brings changes in the production chain, while socialization of production organizations and social manufacturing represent the development direction of digital economy [11-13]. From informatization to digital economy, only by studying and adapting to the changes brought by informatization can we combine the theories of urban science with social development to promote digital city construction in an orderly manner.

(6) The theory of urban science needs to be supported by the study of urban transportation. Urban transportation is an important part of urban science. It inherits the theoretical conception and research methods of urban science established by Qian Xuesen and embodies the objective requirement

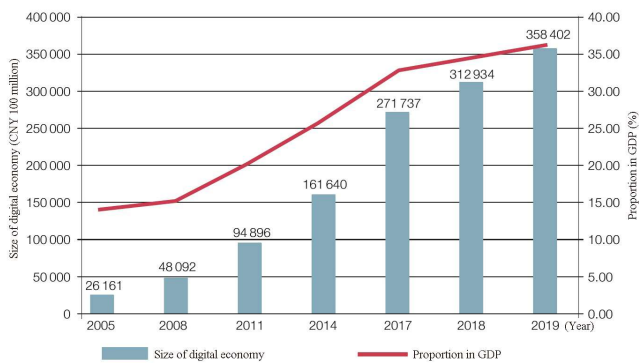


Figure 7 Years 2005–2019, China’s digital economy scale and proportion in GDP

that urban science needs to be improved in terms of research theories and methodological paradigms in the era of new urbanization and information. Academic research, especially in the urban transportation science with the wide application of new technologies, services, and models, has become the forefront of urban science and an important momentum for the development of urban science. It is necessary to study the theory of urban transportation with multidisciplinary thinking and systematic theory from the perspectives of the material and spatial forms of cities and of building smart cities. Urban transportation should respond to the demand for improving people’s quality of life and the demand of the growing urban population. Urban transportation science as an indispensable component of urban science is directly related to the implementation and improvement of urbanization strategy. Urban transportation is dynamic and not in static physical and spatial forms. The study of human activities, including the effect of information technology on resident travelling, needs the support of research on urban transportation.

(7) Objectives and connotation of urban transportation science. The openness of city leads to the intersection, openness, and inclusiveness of urban transportation science. The connotation of urban transportation science includes the following aspects. (1) Serving people’s needs and organizing urban operation are based on the research on human behaviors, with urban economic and social development as the basic requirements. Urban transportation should be studied at different levels of human needs and is directly related to the development of urbanized areas^[14]. (2) We should accelerate the cultivation of modern metropolitan area and enhance the competitiveness of urban agglomeration, which fully reflect the characteristics of its development stage and the openness of urban transportation. (3) Transportation leads the development of new business models, fully reflecting the inclusiveness of urban transportation in supporting innovative development. New technologies and business models can be employed to improve the equity of travelling services provided to urban residents.

Urbanization strategy is related to the route of urbanization in China. Informatization changes people’s demand and urban operation mode. It is an urgent task to use urban science to guide the research on urban development, and in particular to improve the strategy of urbanization. The unpredictability of city future development is becoming increasingly apparent. To make city a space for people living a high-quality life, we should solve the problems of urban operation by using proper theories and methods under the guidance by Marxist philosophy and system theory as well as Xi Jinping’s thought of socialism with Chinese characteristics in the new era, rather than solving isolated single problems. Cities should be considered as the demand of human activities in the material network, and urban planning should support possible changes in the future with a systematic social science approach. Urban transportation is directly related to the improvement of urbanization strategy. The study of population mobility, including information network changes, needs the support of urban transportation science.

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