

A Discussion on the Virtual and Real Structure and Spatial Hierarchy of Knowledge Infrastructure Construction

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Abstract: Under the background of knowledge economy, knowledge plays an increasingly important role in the construction and development of the national economy. As the basic support system for knowledge exploration, discovery, innovation and communication, the construction of knowledge infrastructure is related to the national innovation and development strategy. This paper discusses the rules and requirements of knowledge infrastructure construction from the two dimensions of virtual and real structure and spatial hierarchy. In terms of virtual and real structure, the construction of knowledge infrastructure should accurately grasp the respective advantages and functions of physical knowledge infrastructure and virtual knowledge infrastructure based on information technology, and promote the coordinated development of the two infrastructures. In terms of spatial planning and construction, the construction of knowledge infrastructure should be promoted step by step from the national macro strategic level to the village and town communities according to the hierarchical overall planning of the development stages of each region.

1. Introduction

In the era of knowledge economy, knowledge plays an increasingly important role in the construction and development of the national economy. In this context, research on how to promote knowledge exploration, dissemination and innovation has begun to rise and continue to develop. In view of the importance of infrastructure, academic research on knowledge infrastructure has also been carried out. Knowledge infrastructure is a major infrastructure content related to the national economy and the people's livelihood and the national innovation and development strategy. The construction and improvement of knowledge infrastructure is of great significance for promoting high-quality development of social economy.

2. Review of Research Contents of Knowledge Infrastructure

2.1 The budding concept of knowledge infrastructure

David Sless analyzed the nature and transmission conditions of knowledge and believed that the connotation and boundary of infrastructure are also undergoing major changes in the context of the era of knowledge economy. Knowledge transmission is not "simply transferring information from one place to another".^[1] H. Dieperink & P. Nijkamp analyzed the relationship between R&D infrastructure and spatial spillover of enterprise innovation behavior based on the micro-data of entrepreneurship and innovation in the Netherlands, but failed to pass the Kendall consistency test due to the defects of samples and indicators.^[2] Kiyoshi KOBAYASHI showed that the level of knowledge infrastructure provided by the public sector and enterprises and its use time are the main decision variables that affect the innovation behavior and performance of knowledge-based enterprises.^[3] The research of Branko Zebec & Davor Sostaric showed that the gap between Yugoslavia and developed countries can be narrowed by using the Yugoslav Science and Technology Information System (SNTIJ) to connect the Yugoslav network with the international network, and the Yugoslav academic institutions can access the databases at home and abroad in Yugoslavia and participate in the creation of new knowledge.^[4] Brian R. Gaines pointed out that the paper journal has been the main form of academic communication for more than 300 years, but since the 1970s, the use of computer and communication technology as a new form of scientific communication, such as electronic journals or digital journals, has been more and more strongly verified.^[5] Sawaragi Tetsuo clearly pointed out that with the continuous development of information networks, the Internet will evolve from the current media to knowledge infrastructure.^[6] Eelco Kruizinga & Gertjan Van Heijst ET (1996) believes that organizational learning should be a management process aimed at knowledge creation, distribution, combination and integration. Information technology should enable the infrastructure to have three special functions: (1) enable people to find and contact each other based on their knowledge and experience, not just their names and phone numbers; (2) "Product integration" of knowledge and ensure that they can be consumed and used; (3) Share experience.^[7]

2.2 Definition of Knowledge Infrastructure

Eelco Kruizinga & Gertjan Van Heijst ET believes that knowledge infrastructure is a kind of infrastructure based on information technology platform to realize the three functions of "contact and exchange between people, 'product integration' and experience sharing of knowledge".^[7] In 1998, the World Bank put forward the concept of knowledge infrastructure in the 1998 World Development Report. It believed that knowledge infrastructure was an "organization and means of knowledge production, dissemination and diffusion", and that knowledge infrastructure was the "fourth infrastructure" after transportation, energy and communication. D.M. Amiden and D.J. Skum believed that the knowledge innovation infrastructure is the "supporting means" of the "cooperation plan that links different knowledge activity subjects and enables each subject to benefit from it".^[8] Zhou Dejun believed that knowledge infrastructure is "a super-large knowledge and information management system based on basic and cutting-edge knowledge and expert knowledge and experience of various disciplines and supported by high-performance computers and information infrastructure".^[9] According to Huo Mingyuan, a country's economy depends not only on the level of activity of innovation, application and dissemination of knowledge within the country, but also on the social mechanism of promoting innovation, application and dissemination of knowledge within the country. This mechanism also needs infrastructure at the national level to ensure. This infrastructure is reported by the World Bank as "National Knowledge Infrastructure"

(NKI).^[10] Shen Jing and Sun Rong believed that the infrastructure of knowledge-based service industry is "to promote the production and dissemination of knowledge, promote knowledge innovation, and face the operational knowledge base of various industries and disciplines", and is composed of high-quality and highly skilled talents, knowledge-based service institutions, social knowledge networks, and information infrastructure.^[11] According to Wang Zhiyi, knowledge infrastructure is "the infrastructure built to promote the creation, innovation, application and promotion of knowledge, including soft and hard facilities."^[12]

3. Research on Knowledge

Chen Guoquan pointed out that knowledge is the correct or wrong reflection of the original image and laws of nature and society. Knowledge exists in three places: the history and reality of nature and society, and human brain and media records.^[13] Zhang Ying and Wu Zhong believed that people can use knowledge base and knowledge map to obtain explicit knowledge, but it is difficult to obtain tacit knowledge through media.^[14] Yang Yunfang and Cheng Lianjuan believed that tacit knowledge is more innovative than explicit knowledge. Implicit knowledge includes personal deep understanding of the objective world, unique discovery and creative thinking, which can directly produce innovative results.^[15] Zhang Caiming believed that building an open virtual community is conducive to the spread of tacit knowledge.^[16] Zhao Rongying, Liu Zhuozhu, etc. (2020) further studied and found that under certain conditions, tacit knowledge and explicit knowledge can be transformed into each other.^[17]

In recent years, with the deepening of academic research on knowledge, the scope of knowledge infrastructure and its construction is also evolving and sublimating. Based on the existing research results, this paper will discuss the laws and requirements of knowledge infrastructure construction from the perspective of virtual and real structure and spatial hierarchy.

3.1 Correctly understand and handle the relationship between "reality" and "emptiness"

The concept of knowledge infrastructure stems from the thinking of western scholars based on IT information technology on the public system support methods, means and approaches in knowledge dissemination and exchange in developed countries. In the process of research, construction and application of knowledge infrastructure, we should make rational and dialectical analysis and thinking in combination with China's specific national conditions.

Foreign developed countries have established a relatively complete physical infrastructure system for knowledge exploration, communication and innovation on the basis of long-term, complete and highly industrialized. For example, Hong Fanglin and Shu Man showed that the United States has demonstrated accurate classification services for readers in the field of library construction, including special services for young children, adolescents, the elderly, the disabled, immigrants and other groups at different levels.^[18] He Siqian and He Ding showed that in terms of the depth of library construction, the construction of American libraries has begun to reach the community level. In addition, there is still a large gap between China and developed countries in many fields such as laboratory, communication, information construction, etc. Therefore, in promoting the construction of national knowledge infrastructure, we should not only pay attention to the construction and application of information technology-based communication and dissemination platforms, but also pay attention to the promotion and improvement of physical knowledge infrastructure construction.^[19]

The physical knowledge infrastructure and the "virtual" knowledge infrastructure based on information technology have different characteristics and advantages, and they are also complementary in function. The source and subject of knowledge include nature, society and man,

or man's "inner" and "outer". Human's inherent curiosity about nature, society and self is the prerequisite to drive the subject of knowledge activities to explore, innovate and disseminate knowledge. The "virtual" infrastructure based on information technology has many advantages in the field of promoting knowledge dissemination and exchange, such as all-weather, high efficiency and low cost, but it is not enough to encourage and stimulate the curiosity of knowledge activity subjects to explore knowledge. The physical knowledge infrastructure has the characteristics of intuitive image, multi-dimension and authenticity. Intuitive image is the prominent feature of physical knowledge infrastructure, and it is the key "external" condition that triggers the curiosity and interest of the subject of knowledge activities. Without intuitive and visual contact and recognition of the object, curiosity and interest will also become "passive water", and the content of knowledge activities will also become rigid, rigid, empty and abstract, which greatly reduces the sense of achievement and satisfaction people feel in knowledge activities, even dull and boring. Multi-dimension is another important feature of physical knowledge infrastructure. For the same knowledge object, people can observe and recognize it in a real-time, dynamic and all-round way through the physical knowledge infrastructure, while the "virtual" knowledge infrastructure is often limited by technology or expression logic, and can only display the knowledge object statically to the subject of knowledge activities from the established perspective. Reality is the biggest feature of the implementation of physical knowledge base, and also the most fundamental difference between the implementation of physical knowledge base and virtual knowledge infrastructure. Law is the "truth" hidden behind the objects of knowledge activities such as nature, society and people. The fundamental way to explore and discover the "truth" lies in the recognition of the "real" object. All the content carried and disseminated by the virtual knowledge infrastructure based on information technology is the result of human's existing cognition of knowledge objects, and is the knowledge accumulated by history. The truth endows the knowledge object with obvious normality and unpredictable natural contingency. Human's exploration and discovery of the "truth" behind the knowledge object often comes from the accidental attention and exploration of the knowledge object. The truth is attached to the real "shadow". To discover and deeply understand the "shadow", we can only see it through the truth.

The physical knowledge infrastructure promotes and encourages people to obtain the "truth" under specific dimensions and perspectives through the exploration and discovery of real objects, and realizes all-weather, efficient and low-cost knowledge exchange and dissemination through the virtual knowledge infrastructure. Therefore, in the process of knowledge exploration, discovery, innovation and dissemination by knowledge activity subjects, there is a complementary relationship and nature between physical knowledge infrastructure and virtual knowledge infrastructure. We should have a correct understanding of the complementary relationship between the two, and reasonably grasp and implement the construction structure of physical and virtual knowledge infrastructure. By promoting the collaborative construction and development of physical and virtual knowledge infrastructure, the guiding role of knowledge infrastructure in knowledge exploration and discovery will be significantly enhanced. This move will provide a more scientific platform for deeper innovation and communication, and provide more effective basic support for the implementation of innovative development strategies.

3.2 The spatial hierarchy of knowledge infrastructure construction

The knowledge infrastructure construction project is a gradual and historical project. This gradualness is not only reflected in the gradual and in-depth process of human research on the connotation, characteristics, transmission mechanism and cognitive science of knowledge, but also reflected in the cascade of knowledge infrastructure construction at the spatial level.

Like transportation infrastructure, the promotion of knowledge infrastructure construction should also form the construction echelon of the country, province, city, county and even community villages and towns at the spatial level. In the construction of knowledge infrastructure, local governments at all levels have different responsibilities and priorities for the construction of knowledge infrastructure. Knowledge infrastructure based on the national level should be designed and constructed at the strategic level from the perspective of synergy, equality and open development. The objects of coordination, equality and openness include various subjects of knowledge activities, including support for openness and equality of provincial, municipal, county and township communities at the macro level, as well as support for individual enterprises, organizations, groups and individuals at the micro level. On the basis of the national strategic planning and system requirements for the construction of knowledge infrastructure, all provinces, cities, counties and even villages and towns should, in the process of building and improving knowledge infrastructure, combine with the actual situation of the region, scientifically plan the construction system and key points, make overall arrangements, reasonably divide labor, and promote the construction step by step. Because of the objective differences in nature, history, humanity and economy among regions, the environment of the subject of knowledge activities is also different, and the object categories of a series of knowledge activities such as people's cognition, perception and exploration are also different. Therefore, each region should respect and face up to its own objective development stage and the object category of regional knowledge activities for characteristic construction.

Strategic knowledge infrastructure based on the national level and regional knowledge infrastructure at all levels are also organic complements. Based on the systematicness and complexity of IT information technology, the construction of knowledge infrastructure at the national level can focus on system planning, security implementation and the construction of knowledge dissemination and exchange platform, namely the construction of virtual knowledge infrastructure. For the knowledge infrastructure in the key and major knowledge activities related to the national economy and people's livelihood, the state can also concentrate resources to carry out orderly, phased and coordinated construction. In the construction of local knowledge infrastructure, regions should focus on the construction of physical knowledge infrastructure, such as the construction of local universities and primary and secondary school libraries and electronic reading rooms, museums, exhibition halls, academic exchange centers, public libraries and laboratories. In general, in the construction of knowledge infrastructure at the national level and the construction of local knowledge infrastructure, the country and the local can carry out reasonable division of labor based on the physical and virtual forms of knowledge infrastructure, each with its own emphasis, complement each other, and cooperate to complete the system construction and improvement of knowledge infrastructure.

In addition, the spatial hierarchy of knowledge infrastructure construction is also reflected in the adaptation to the hierarchical characteristics of the economic and social development stages in various regions of China. The echelon of regional economic and social development is not only manifested in the development stages of the eastern, central and western regions, but also in the development stages of urban and rural areas, large and medium-sized cities, and urban central and peripheral areas. Therefore, in the process of promoting and improving the construction of knowledge infrastructure, we should also combine the objective conditions of the development of various regions.

4. Conclusion

Knowledge infrastructure and its construction are related to the national innovation and

development strategy. A scientific understanding of knowledge infrastructure and its construction laws is the premise and basis for building and improving knowledge infrastructure. In the construction of knowledge infrastructure, paying attention to and ensuring the rationality of the construction structure of physical knowledge infrastructure and virtual knowledge infrastructure, scientifically planning and promoting the coordinated development of the two kinds of knowledge infrastructure is an important guarantee to play and improve the efficiency of knowledge infrastructure in knowledge exploration, discovery, innovation and dissemination. At the same time, we should objectively understand the current situation of China's economic development, respect the hierarchical nature of development stages between regions, promote the planning and construction of knowledge infrastructure from the national level to the village and town communities, and ensure the systematic and coordinated construction and development of knowledge infrastructure between regions, urban and rural areas, and urban centers and the periphery. According to the above, this paper gives two suggestions as follows:

4.1 Promote the construction of physical knowledge infrastructure and virtual knowledge infrastructure as a whole

People will be affected by a series of psychological factors in knowledge activities, such as curiosity and interest. Curiosity and interest are the internal instinctive driving factors for people to explore and explore knowledge objects. They originate from the internal "resonance" of the subject of knowledge activities to the intuitive, concrete and novel knowledge objects. People's sensitivity to perception and perception of knowledge objects will be affected by the distance between the subject of knowledge activities and the knowledge object. The more intuitive, vivid and real the knowledge object is, the more profound people will feel and recognize the knowledge object, that is, the so-called "seeing is better than hearing". Even in the process of knowledge dissemination, the intuitiveness and authenticity of the contact and communication between the subjects of knowledge activities will also affect the efficiency of knowledge dissemination. For example, education based on Internet platform cannot fundamentally replace traditional classroom education. The physical knowledge infrastructure endows the process of knowledge activities with more humanistic care and emotion, making the "cold information" warm in the dissemination. Although the virtual knowledge infrastructure based on information technology can achieve the speed and breadth of knowledge dissemination, it is difficult to ensure the quality and depth of knowledge dissemination. Therefore, in the process of knowledge infrastructure construction, the relationship between "reality" and "emptiness" should be correctly understood and recognized, and the coordinated development of the two should be reasonably planned and coordinated.

4.2 Promote regional knowledge infrastructure construction in echelon

From the national level to villages and towns, the construction of knowledge infrastructure should be systematically promoted. In the spatial planning and construction, the objective status quo of regional development and the hierarchical nature of development stages should be respected. The objective differences in regional development stages determine the differences in cognitive objects, interest orientations and categories of knowledge activity subjects in different regions. For example, the interest orientation of knowledge activity subjects in rural areas is more significantly closely related to agricultural production. The interest of knowledge activity subjects in urban industrial areas is mainly concentrated in manufacturing, technology or management, while the interest of knowledge activity subjects in megacities and large urban centers is concentrated in finance, research and development and trade. For the equal, open and standardized knowledge exploration, innovation and dissemination services realized by the virtual knowledge infrastructure based on

information technology at the national level, each region should focus on promoting the construction of physical knowledge infrastructure with local characteristics in combination with the objective status of its own development, and realize the all-round promotion and improvement of knowledge infrastructure construction from the national macro strategic level to the village and town communities.

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