

# Thoughts and Suggestions on China's Smart City Building

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With the rapid development of the global economy and the increasing mobility of capital and labor, urbanization is gaining more momentum. After more than 40 years of reform and opening up, urbanization in China has been accelerating with approximately 15 million people moving into cities every year. By 2025, China will enter a new era of urban society with nearly two-thirds of China's population living in urban areas. However, along with the urbanization movement have emerged plenty of "urban diseases", such as overpopulation, industrial pollution, traffic congestion, and resource shortages. The relatively backward social management and social services have imposed significant obstacles for the future development of cities. When cities face these substantive challenges, existing urban governance models must be innovated and developed.

Following digital city, smart city is an advanced representation of information technology, which integrates information technology, industry, and urbanization. Smart cities enable more scientific management of cities, more people-oriented services, and more sustainable urban development. It is an important means to enhance urban competitiveness and tackle some urban development issues. Smart cities are also regarded as an important area for economic revitalization. In the process of building smart cities, industrial upgrading and the development of

strategic emerging industries will be realized, and the transformation of economic development models will be further promoted.

However, we need to draw upon the experience from smart city building of other countries and address potential issues to effectively build our own smart cities in their true sense, and further identify the key issues and overall framework of smart city building, so that the building of smart city can be incorporated into a more effective and scientific framework to fulfill people's vision of this cause.

## I. The Status Quo of Smart City Building Overseas and Their Experience and Insights

At a session of the Council on Foreign Relations held in New York in November 2008, IBM first put forward the concept of "smarter planet", which in turn triggered a wave of smart city building.

1) As European and American countries enjoy more mature urban landscape and their urban development is in the post-industrial stage, these countries pay more attention to the service provided by cities in the exploration and practice of smart cities. Aiming to meet the actual needs of citizens, new generation of information technology is employed to build facilities with sensors based on various networks, and provide smart services through information fusion analysis (Song, 2012).

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2) In the era of knowledge economy, the building of smart cities in European and American countries also prioritizes citizens, focusing on open and innovative space for user engagement, which embodies the concept of smart city innovation 2.0 that puts people first, strengthens services and value creation.

3) Prioritize applications and promotions of innovations in two aspects, namely, the community in big cities and small and medium-sized cities. The most important experience in innovation promotion in European and American countries is to start with “small steps”, gradually promote and replicate the successful experience of a single project or field to different communities in the entire city, and form a complete smart city system eventually.

4) The model of using pilot projects to drive technology applications is a common practice in smart city building in European and American countries currently. Different cities have their own priorities. The top two focus areas are energy conservation and emission reduction in the environmental category and people’s livelihood in the social category.

## **II. The Status Quo and Existing Problems of Smart City Building in China**

In terms of smart city building and industrial development, the central and local governments in China attach great importance to the introduction of a series of relevant policies of smart cities. A standard system has initially taken shape and the building of smart city pilot projects is in full swing with the comprehensive upgrade of urban information infrastructure, and more focused development of management services. “Internet+” and big data have spurred the development of smart industries. The development of e-commerce in China is leading in the world, and new technologies, models and types of businesses emerge from time to time. While the smart city building in China has achieved rapid development, the following issues have surfaced, which deserve meticulous research and are expected to be resolved in the future.

### **2.1. A Simplified concept solely focusing on information technology, without clarifying the core issues and significance of smart city building**

A smart city is a new concept and model that employs new generation of information technologies such as the Internet of Things, cloud computing, big data, and spatial geographic information integration to promote the smart integration of urban planning, building, management, and services (Eight ministries including the National Development and Reform Commission, 2018). The current progress is mainly focused on information technology, which leads to the building of numerous facilities, hardware, and software systems. However, there is a lack of research and planning in the real-time acquisition of information and smart analysis of information. The core of a smart city in the complete sense lies in intelligence, that is, the ability to obtain real-time information for analysis and judgment that is equivalent to the “senses” and “brain” of humans. Therefore, high-performance sensors are required to conduct model analysis or big data analysis for different physical processes. A smart city is a collection of countless smart complex systems in a city. Each smart complex system consists of three aspects: real-time information acquisition, smart analysis, and timely response. At the same time, it employs communication networks, big data, cloud computing, and physical models of processes as basis.

### **2.2. A lack of open and unified urban network information space at the information level**

The building of a smart city is based on data. Without data collection, transmission, storage, deep processing, and reprocessing, there will be no smart management and decision-making. Since China has not yet formed a unified smart city architecture system at the national level, and lacks overall top-level guidance, it is inevitable that each city works on their own and builds overlapping systems during the implementation process, forming many isolated islands of information.

### **2.3. The building of smart cities prioritizes infrastructure without breeding an innovative application environment**

China is currently in the stage of large-scale urbanization, and the urban infrastructure is not well-established yet. Smart cities hence prioritize the building of information infrastructure. In addition, in the development of smart cities in China, the government

is playing a dominant role in the employment of information technology. Enterprises and the public engagement are not fully leveraged. The smart city development model led by the government, corporate investment and public participation has not yet been formed, and people-oriented services and open, innovation-oriented urban ecological environment have not yet been established.

#### **2.4. Lack of diversity in investors with heavy burden on national finance. Public-private partnership has become the mainstream investment and financing model for smart city building**

At present, the state is dominant in investment and building of smart cities, but smart cities often involve technical transformation of urban management systems. These transformations require large capital and higher costs of risks. In addition, enterprises would be well-placed to undertake many smart city projects such as smart medical care and elderly care based on market mechanism. In 2015, the National Development and Reform Commission, the Ministry of Finance, and local governments issued relevant policies for government-enterprise cooperation, and public private partnerships (PPP) have gradually become one of the important investment and financing models for smart city building.

#### **2.5. Lack of differentiated smart city planning that matches the local information infrastructure**

Since China spans over a vast territory, different regions have different levels of productivity, information infrastructure, and stages of smart development and positioning goals. The three stages of smart cities, namely, digital city information, city information resource sharing, and smart city, shall be implemented gradually. Therefore, identifying the positioning and phased goals that match the status of the city, and selecting the key focus for the near future are the basic prerequisites for advancing the building of smart cities.

#### **2.6. Lack of breakthrough in key technology, and an industrial cluster with international competitiveness has not yet been formed**

The key technologies of smart city building, such as the Internet of Things, cloud computing, integration of three networks, and wireless broadband, are expected to

further develop. Areas to be further strengthened include sensors, smart analysis models, research on the patterns of big data and core technologies, as well as their applications and industrialized development. Although artificial intelligence technology in China has scored many impressive achievements, it cannot meet the requirements of the national development strategy and lags behind the international advanced level. The lack of breakthrough in the new generation of information technology and smart applications have become a bottleneck of the development of smart cities.

### **III. Some Thoughts on the Building of Smart Cities**

#### **3.1. Strengthen the understanding of the core significance of smart city building**

At present, there is no unified definition of a smart city. In fact, smart earth and cities alike result from the accumulated integration of smart processes occurring in different regions. A smart city is a collection of countless smart complex systems in a city. Each smart complex system consists of three aspects: real-time information acquisition, smart analysis, and timely response. At the same time, it employs communication networks, big data, cloud computing, and physical models of processes as basis. The expansion of regions, the accumulation of processes, and the deepening of smart application will gradually form smart regions, smart cities, and even smart earth. This is a gradual process, and the extent of smart application is gradually deepening. We believe that the core significance of smart city building is: smart city = Internet + Internet of Things + smart analysis and control.

#### **3.2. Strengthen the understanding of the overall structure of smart cities**

The concept of “smart city” is very extensive, which can be summarized as “one, two, three, four, and five”.

*One* goal: enter an era of intelligence. A big wave of information fusion is gaining momentum. “Information fusion” refers to the integration of human intelligence into a specific physical system, so that the sensors in a physical system can automatically analyze the meaning of the information according to the physical model input in advance after the sensors

obtain information in real time, so that the physical system can function “smartly”. The physical model entered in advance is established by human scientific practice, which is a representation of human wisdom. This is the smart process of physical systems, leading humans to an intelligent era.

**Two** core technologies: real-time perception technology and intelligent analysis technology. The use of advanced sensor technology allows real-time acquisition of information. After the information is obtained, the core is to interpret and analyze the meaning of the information. Smart analysis technology must rely on pre-established empirical models, theoretical models or big data analysis to make analysis and judgement. Only by modeling and analyzing different material processes can accurate analysis and judgment be made.

**Three** basic information technologies: Internet, Internet of Things, and big data and cloud computing. The Internet is an information network platform between people, and it is also the most basic and important information network platform. The Internet of Things is a network that connects object information with the Internet through information sensing equipment based on predetermined protocol to realize smart identification, positioning, tracking, monitoring and management. Big data and cloud computing technology is the technical ability to obtain valuable information rapidly from various types of massive data with the cloud network to complete processing and analysis. Key technologies include data collection, data preprocessing, data storage, data processing, data analysis, and data visualization technology, etc. Other technologies, such as remote sensing, satellite positioning, and geographic information systems can be utilized to collect, process, and update various spatial and environmental information. Technologies in indoor positioning, network communication, modeling and simulation, metadata, artificial intelligence, and security are also necessary application technologies.

**Four** technical layers: perception layer, interconnection layer, analysis layer, and reaction layer. At the technical level, a smart city should have at least a framework encompassing these four layers, meanwhile a safety guarantee system and a standard system are also required as a support. 1) *Comprehensive and thorough real-time perception*: embed and equip sensors in a

variety of objects, link the Internet, communication networks and various equipment and objects equipped with sensors, and use any devices that can sense, measure, capture and transmit information to form an unprecedented Internet of Things. This profoundly integrates the human society with physical systems, rapidly obtaining and analyzing any information in the city, and facilitates immediate response measures and long-term planning. 2) *Universal broadband interconnection*: link, interact, share, and coordinate the scattered information and data collected and stored them in the multi-information system between multiple parties by utilizing various forms of network tools, thereby allow real-time monitoring of the environment and business conditions, analysis of the development of the city from a comprehensive perspective and solution of problems in real time, in the end changing the way of entire city operation. 3) *Smart fusion of analysis and judgment*: use pre-established physical models of different processes to conduct big data analysis and judgment, employ advanced technologies such as high-performance computers and cloud computing to integrate huge amounts of data and information for in-depth analysis and complex computing, and conduct in-depth analysis of the collected data to realize smart analysis and judgment. 4) *Timely and rapid response*: take timely actions to effectively solve specific problems based on smart analysis and judgment, to better support the normal operation of various processes in various regions of the city, promote urban development decisions, actions, and create new values.

**Five** major applications respectively in urban comprehensive management; transportation, logistics and trade; energy and environmental safety; medical and cultural education; and urban community life. A smart city is a smarter way to change the interaction between urban government management, business operations, and the work and life of citizens by using a new generation of information technology to improve the clarity, efficiency, flexibility and response speed of interaction. The integration and large-scale application of existing Internet, sensors, smart information processing and other information technologies will become one of the new pillars of economic growth points in the future. Therefore, smart cities can be extensively deployed in the following five major areas:

1) *Smart city comprehensive management*. Establish an integrated management and operation platform in the smart city to unify data and network, build a data center and a sharing platform, fundamentally and effectively interconnect the data and information of various government departments, and provide technical support for the scientific guidance and decision-making of leaders. 2) *Smart transportation, logistics and trade*. Build a smart transportation system to enable the sufficient sharing of traffic information, real-time monitoring, and dynamic management of road traffic conditions. In the logistics industry, accelerate the building of logistics information platforms based on the Internet of Things and fourth-party logistics information platforms, and promote the development of information-based, standardized, and smart logistics enterprises and the logistics industry. Actively promote the building of e-commerce platforms, and encourage the development of industry-based public information service platforms that take e-commerce platforms as the aggregation point. 3) *Smart system for energy and environmental safety*. Build a smart distributed energy system to conduct smart testing and coordinate the optimal and efficient use of energy flow. Obtain river hydrology and ambient air information in real time, deliver reports, and take relevant measures after smart analysis. 4) *Smart medical, cultural and educational services*. Build a smart system for medical, health care, cultural, and educational services, and achieve an optimal solution for medical services. Actively promote the building of a smart cultural and educational system to create a learning-oriented society. Strengthen the integration of information resources and improve the public cultural information service system. 5) *Smart urban community life*. Carry out smart community pilots in some residential communities, fully consider the different needs of public areas, business districts, and residential areas, integrate and apply various information technologies such as the Internet of Things, the Internet, and mobile communications to develop community management systems, smart home systems, smart building management, smart community services, remote community monitoring, security management, smart business office and other smart application systems, enabling residents to enjoy “smart development” in life.

## **IV. Suggestions on the Building of Smart Cities**

### **4.1. Vigorously develop technologies for sensors, the Internet of Things and smart recognition**

Real-time information acquisition based on sensors and smart information recognition based on specific physical process models and big data analysis are the core technologies for smart city building and the prerequisite for the Internet of Things. Sensors are the source of information generated by the Internet of Things. The Internet of Things connects physical objects to the Internet through information sensing equipment. Multi-type sensing technology, multi-spectrum and multi-dimensional information fusion and integrated sensing technology are the “senses” for effective applications of the Internet of Things, just like human eyes, nose, ears, tongue, skin, *etc.* Smart analysis and control are the brains of the Internet of Things. Smart analysis and identification shall prioritize the establishment of analysis models according to different physical processes, and leverage the role of big data analysis. It is recommended to map out a layout planning for the R&D and innovative applications of key technologies at national, provincial and city levels.

### **4.2. Build a network information space in smart cities, breakthrough the fragmentation of urban information, and provide data flow channels for the application of the Internet of Things**

It is advisable to build a network information space in smart cities through combining the Internet, the Internet of Things, telecommunications networks, radio and television networks, and wireless broadband networks. The urban network information space is a brand-new dimension that is different from the real space of human beings. It is the second space and virtual space of human beings. Smart cities leverage the new generation of information technology to promote the in-depth integration of information space, physical space (various buildings, hard objects), and social space (social network formed by people) in the city, and accelerate economic development and transformation through rich application of systems, improve the efficiency of government and public services, facilitate the work

and life of citizens, effectively protect and utilize the environment, and enable the harmonious development of the economic and social environment.

#### **4.3. Build new industries for smart cities**

As the profound extension and integrated application of information technology, smart city is one of the important areas for potential breakthrough in new generation of information technology and an important part of the development of global strategic emerging industries. Smart city building drives the development of strategic emerging industries such as large-scale sensors, Internet of Things, smart system, distributed new energy Internet, smart manufacturing, smart city management, and guide industrial transformation and upgrading.

#### **4.4. Establish a new model of smart city development with the “Internet +” smart community as a pillar**

The smart community is an epitome of smart city. It is an important part of the building of smart cities, including basic environment, basic database group, cloud exchange platform, application and its service system, and security system. Meanwhile, new business and models such as smart elderly care, medical care, and education provide sustainable growth momentum for the building of smart cities.

#### **4.5. Promote the utilization of circular economy and new energy with “Internet +”**

Efforts should be made to leverage circular development to drive actions, and carry out a pilot project of waste recycling system based on “Internet +”. It is advisable to develop the energy network, promote pilot projects for the use of new energy, and enable the smart use of new energy technologies.

#### **4.6. Establish and improve a smart city evaluation system**

At this stage, the research on the evaluation index system of smart city focuses on the basic components of the framework system of smart city and presents the basic standards that a smart city must meet. Each city and specific functional department can add their own complementary parameters based on their own functional positioning and development features.

#### **4.7. Strengthen the legal system building of smart city**

The building of smart cities is not only a technical issue, but more importantly, it involves the innovation of institutional mechanisms and the corresponding legal system building. Data is the key element of smart city building, and integration of resources is the essential content of smart city building. Only by strengthening the reform of the administrative system, establishing a strong promotion and coordination institution based on laws and standards, and intensifying law enforcement, can it be possible to break down industrial barriers and break up the information monopoly.

(Translated by SONG Xinyi)

#### **Reference**

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