Current Problems and Restructuring Suggestions for Smart City Construction: A Case Study on Fight against COVID-19 in Several Chinese Cites

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ABSTRACT

Smart city construction is one of the key processes towards global urbanization. The previously advocated principle of "people first" has actually not been achieved during the past days of smart city construction. COVID-19 that threatens the entire world this year is exactly a test to the functions of smart city. Despite the rich experience accumulated, a great number of problems are exposed, including focus on infrastructure construction while ignoring scenarios application, and prioritizing resources input over people's demand. This paper summarizes the typical practices taken by the Chinese smart cities in fighting against COVID-19 and some existing problems, introduces the "Panoramic Standardized Scenario Matrix" as a main tool and proposes smart cities to be restructured from such dimensions as top-down design, construction processes and effect assessment.

CCS CONCEPTS

• **Social and professional topics** → Computing/technology policy; Government technology policy..

KEYWORDS

Smart City, COVID-19, Two-way Collaboration, People First, Demand Scenarios

1 CURRENT SITUATION AND DEVELOPMENT TRENDS OF SMART CITY

1.1 Background

As urbanization across the globe is taking on a vigorous and irreversible momentum, the common problem faced by the mankind is that by 2050 nearly 70% of the world's population will live in cities facing great challenges such as urban governance and sustainable development. Many countries and regions have included smart city construction as one of their key strategies for development, and have formulated and implemented a series of policies and measures therefor. In general, unlike previous stages of development, smart city construction is faced with both important historical opportunities and unprecedented challenges.

First, the new generation of information technologies is booming. On the one hand, smart city construction provides more diversified scenarios for the rapid development of mobile Internet, big data, cloud computing, blockchain, IoT and other ITs, while on the other hand, these ITs in turn facilitate smart city construction. Second, more focus is placed on the human development needs for applications. Smart cities ultimately take people first and stand ready to serve people, presenting more applications in the field of livelihood with increased concern attached to vulnerable groups. Third, the development model of digital economy is shaped. As an asset, data has become a new resource for urban development, and industrial digitalization and digital industrialization provide new targets of industrial development for smart city construction.

1.2 Current Studies

Experts and scholars in relevant fields have conducted a great number of researches and practices on new smart city. Fan Youshan (General Manager of China Electronics Technology Group Corporation) believes that "new smart city" aims at serving people all day round, efficient and orderly urban governance, open and inclusive data sharing, green and open economic development, and clear and safe cyber space. It promotes the deep integration and iterative evolution of new generation of ITs and urban modernization through system planning, information guidance, reform & innovation, thus achieving the coordinated development between the country and the city.[1] According to Xiong Qunli (Chairman of China Electronics Technology Group Corporation), new smart city refers to achieving deep integration and iterative evolution of the new generation of ITs and urban modernization through

system planning, information guidance, thus bringing more modern governance, smarter operation, safer development and happier life. Its essence is to improve the governance system and governance capability of government and society to better serve the people. New smart city shall be constructed following the principle of constructing a set of system architecture, an integrated grid, a general functional platform, a data set, a city operation center and a set of standards. As believed by Jiang Peng (Director of the Big Data Institute of China Center for Urban Development of the National Development and Reform Commission), the orientation of new smart city construction lies in further enhancing the level of convenience and benefit for the people in the city, improving the modernization level of urban governance capability, achieving the sustainable development of the city, increasing the happiness and sense of acquisition of urban residents, and enabling the public and enterprises to really benefit from smart city construction. Shan Zhiguang (Deputy Director of the Information Research Department of the State Information Center and Secretary General of Smarter City Development and Research Center) believes that new smart city is a smart city that implements China's new urbanization plan, features Chinese characteristics, embodies the new policy mechanism and innovation in development model, with people first as its core, construction effect as the key, and reform and innovation as its essence.[2] According to Lv Weifeng (Head of the National Standardization General Working Group on Smart City and President of the School of Computer Science and Engineering of Beihang University), we must build an IoT-based complete smart city system featuring five dimensions of sensing, connecting, knowledge, application and integration, and apply different construction modes for different categories of cities classified by city functions, locations, economic level and living standard. [3]Andrea Caragliu, Chiara Del Bo and Peter Ni Jkamp believe that smart city construction should be demand-oriented, with emphasis placed on communication facilities construction, information management, and social efficiency improvement.[4] According to Zhong Shan (Academician of the Chinese Academy of Engineering and Consultant of the Science and Technology Committee of China Aerospace Science and Industry Corporation Limited), thanks to the smart technologies, smart cities enable centralized gathering of public data, and help establish and improve the inter-departmental data sharing and circulation mechanism for efficient resource allocation and optimized governmental governance. Today, the systematic construction of smart city helps effectively reduce personnel concentration, avoid errors, delays and other problems caused by manual transmission of data, and enables early warning for effective prevention and control of COVID-19. In the long run, it functions to promote the upgrading of urban governance and development of digital economy.[5]

2 ROLES OF AND CHALLENGES FOR NEW SMART CITY DURING COVID-19 EPIDEMIC

2.1 Important Roles of Smart City in COVID-19 Prevention and Control

Smart cities play an important role in distributing supplies, managing personnel, running public transport, and delivering medical services and education services during the fight against COVID-19. Cases in Jinan, Beijing and other places are presented below.

2.1.1 Jinan. First, the demands for materials are identified applying big data to ensure material supply. Epidemic monitoring and command system of Jinan's "City Brain" mainly collects and analyzes data in several key fields like epidemic monitoring, medical resources and material support. Health, operators, Internet and other data are aggregated for visual presentation of such information as epidemic infection situation, development trend, and medical resources allocation. Dynamics of all kinds of materials can be learned in real time for more informed material supply and allocation. In the meantime, online epidemic prevention material booking system is built for local residents to get materials in a safe and convenient manner.

Second, the industrial enterprise big data platform guarantees safe resumption of production and work. Jinan takes the lead in work and production resumption thanks to its "questionnaire system of the epidemic impact on enterprises" and "analysis system of the epidemic impact on enterprises in Jinan". The enterprise social credit system in smart city's big data resource is applied for real-time monitoring of enterprises throughout Jinan from such dimensions as production resumption, taxation payment, employment, power utilization, debt ratio, working capital, raw material and industrial chain. Taking "Power consumption" for example, it is possible to get a whole picture about the work resumption of enterprises by comparing the historical data of the same period. The impact on the industry and supporting policies are then assessed after big data-based analysis, so as to make the supporting policies more precise and targeted.

Third, infection sources are effectively blocked through "precise smart control". Jinan has built a platform for monitoring and checking information about people, vehicles and roads, which can rapidly collect information about vehicles, people and their health status, and upload the data collected to backstage for comparative analysis through license plate recognition and hand-held identification card verification terminal, thus increasing the traffic efficiency of vehicles to 30 seconds. Traces of key vehicles are identified immediately thanks to cameras set in the passes deployed throughout the downtown and powerful AI capacity of "traffic brain", thus shunting vehicles from other places outside Jinan, identifying and controlling suspected vehicles for quick disposal. Moreover, statistics and analysis can be made for people entering Jinan from epidemic-prone areas through mobile phone communication data, including person from and passing the epidemic area, or those who have been in the epidemic area recently, thus making clear the trace of confirmed cases for more effective epidemiological surveys. In addition, 50m x 50m full-network grid monitoring of Smart Brain is applied for monitoring and strict control, and a GIS-based person flow distribution thermodynamic diagram is built to check the real time person flow, trend, staying time and other information in each grid, thus offering early warning for dense population gathering.

2.1.2 Beijing. First, Internet and other technologies are applied for cloud-based smart services. Courts in Beijing have moved all services including case filing, litigation and complaint reception to www.bjcourt.gov.cn, Beijing mobile court information platform and other online channels. During the COVID-19 epidemic, "Smooth Finance" WeChat public account, network office and other approaches are adopted for providing such financial services as fund transfer,

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credit financing, loan extension, insurance claim settlement and foreign exchange.

Second, Smart Traffic functions to facilitate safe resumption of work and production. Beijing Public Transport Group provides customized public transport network commuter services for enterprises, institutions and the general public to resume work and production. Upon the online commuter application of employees, customized bus lines are worked out after smart computing of the system in consideration of their actual demands. In the meantime, online ticket reservation service is offered to ensure rapid and non-stop bus commuter services with one seat reserved for one passenger, making one's journey safe and convenient.

Third, the digital industry plays its role in resisting against the COVID-19 epidemic for flourish economy. Beijing Alliance of Industrial Internet released the List of Technical Products and Services for COVID-19 that specifies products closely related to COVID-19 prevention, including virus detection, medical protection, smart diagnosis, epidemic analysis, cyberspace security, and service platforms, to facilitate digital transformation of industrial enterprises and minimize the threat of COVID-19. Beijing has also taken the lead to launch the trans-discipline "employee sharing". Alibaba Local Service Company also presents its "Blue Sea" Employment Sharing Platform to relieve enterprises' pressure in manpower through flexible and accessible short-term employment.

Fourth, online medical treatment eases citizens' anxiety and offers more alternative medical treatment channels. Beijing Medical Association has taken the lead to build the "Online Doctor Consultation Platform of Beijing for Pneumonia Infected in COVID-19" and offered remote consultation, fever clinic inquiry, online registration and other "one-to-one" services for citizens by joining hands with over 10 existing medical platforms like Toutiao, Jingyitong and Haoyisheng, in a bid to provide citizens with home-based expert advice, and avoid or minimize cross-infection due to public consultation in hospitals.

2.1.3 Other Cities. (1) "Health QR Code" makes COVID-19 prevention in Hangzhou more efficient. An exclusive QR code is generated for each citizen or worker returning for work based on big data upon online application, which supports dynamic management at three levels marked by green, red and yellow respectively. Health QR Code can help epidemic prevention departments accurately collect personnel data, making enterprises' work resumption, community- and grass-root-based management even easier. Currently, Health QR Code has been linked with electronic health card and social security card. In other words, citizens are able to see doctors and make settlement with Health QR Code. For example, only drivers with green health QR code can take their post and only passengers with green health QR code can take vehicles.

(2) "Property Management Assistant" helps property management companies in Mianyang effectively fight against COVID-19. Thanks to the "Property Management Assistant", some communities in Mianyang enable IoT-based cloud access control and face recognition, thus effectively avoiding unauthorized access of external personnel. In the meantime, the assistant can also be used for publicity of knowledge on COVID-19 prevention and control, personnel screen, online shopping and delivery.

(3) Internet hospital in Shanghai facilitates the COVID-19 prevention and control. Shanghai has put Guanzhong Internet Hospital of Shanghai Xuhui District Central Hospital into service, which is the first entity public medical institution in Shanghai winning the license for Internet hospital and supports on-card online payment and doorstep delivery of medicines. Shanghai offers the public COVID-19 consultation, popularization of protection against the epidemic, and online voluntary clinics giving full play to the advantages of "Internet + medical treatment & healthcare".

(4) Online education ensures ongoing learning while school education is suspended. Most cities in China have launched their online class. Xi'an has launched video courses successively relying on its quality education resource sharing platform and education channel IPTV. In Nanjing, online courses for primary and secondary schools are broadcast on five platforms, including Nanjing Cable TV, Nanjing Radio and Television APP and Jiangsu Telecom iTV. In Guangzhou, video classes are presented through Guangzhou Smart Education Public Service Platform, Guangzhou Cable TV, Guangdong Cable TV and IPTV, and schools launched recorded courses, live lessons, online Q&A, personalized guidance, etc. to ensure teaching and learning quality.

2.2 Smart City-enabled Epidemic Prevention and Control Scenarios

As smart city construction is in varied progress in different cities, some cities are facing great challenges like outdated prevention & control approaches and poor urban governance ability in fighting against COVID-19 due to weak foundation and slow progress.

2.2.1 Low Efficiency in Basic Data Collection. At the initial stage of COVID-19 prevention and control, some cities applied outdated approaches to collect basic data, which feature great workload, excessive competent departments involved and expertise required, imposing great pressure on grass-roots organizations and wasting much time. All these were directly caused by incomplete and unscientific commanding and coordination system, and lack of a specific information coordination mechanism and convenient yet unified information collection and reporting platform among departments.

2.2.2 Weak Overall Coordination of Material Supply and Demand. In the early stage of COVID-19 outbreak, the demands for and production capacity of masks and other key supplies in Wuhan and some other places were not clearly identified, reflecting the lagging-behind of industrial Internet construction, poor logistics and transport information management, and many other problems.

2.2.3 Low Awareness on the Importance of Digital Technologies for Community-based COVID-19 Prevention and Control. In the early stage of COVID-19 outbreak, communities were the main battlefield to fight against the epidemic, but the digital technology failed to bring its important role to full play. In many superior organizations and communities, there was insufficient key information needed for COVID-19 prevention and control, which needed to be temporarily summarized and dynamically adjusted. To get enough information, primary personnel needed to complete a great deal of sheets and many organizations even designated special persons to complete sheets and report information. However, all these sheets were of slight differences and had too much repeated information. As a

Table 1: Practical Application Scenarios in Some Cities

	Jinan	Beijing	Shanghai	Hangzhou	Mianyang	Wuhan
Material allocation	√					×
Personnel management	√			√		
Data collection	√					×
Public services		√				
Public transport		√				
Online medical care		√	√			
Online education		√				
Property management					√	
Digital industry		√				
Work and production resumption	√	√				

Note: √ refers to that the city in the case played a role in this application scenario; × refers to that the city failed to play a role in the case.

result, lack of digital means further resulted in the lack of standardized core elements. As for this problem, at the press conference of the State Council held on February 10, leader of the Department of Grass-Roots Level Regime Construction and Community Governance of the Ministry of Civil Affairs called that "it is even more important to develop a software product that serves communities in epidemic prevention & control than making billions of donation."

2.3 Summary

Practical application scenarios of smart city construction in the aforesaid cities are briefly summarized in Table 1

3 RESTRUCTURING OF NEW SMART CITY CONSTRUCTION FOR IMPLEMENTATION

3.1 Top-down Design Restructuring: Clarify the Two-way Collaboration Mode

T Top-down Design is the overall concept and strategic design from the top level that starts from overall picture and conditions of the target system and applies the system theory method, and a design method that simplifies, refines and stylizes the complicated problem by step-to-step breakdown and refining from top down. The opposite is "basic level design", i.e. "Bottom-up Design".

In the past, breakthroughs have always been made from a specific point without top-down design. As a result, there is no overall objective, bringing poor overall controllability, isolated efforts, and great barriers for data integration and intensive services in the future. In recent years, top-down design has become a must for smart city construction. Particularly, specific departments like big data bureau are designated to control planning, construction and other affairs in a centralized manner, which significantly improves the integrity and coordination of smart city construction.

However, centralized coordination and distributed demands are always inconsistent, and top-down design is commonly insufficiently practiced in specific scenes with few business divisions involved, thus making application scenarios and top-down design incompatible. In some places, coordination organizations such as "Leading Group for New Smart City Construction" are set up to

solve the aforesaid problems, relieving the situation to certain extent. However, those departments often have vague understanding of the scope and efforts made in this regard due to uncertainties in the identification of demands, supporting technologies, paths and many other aspects during new smart city construction.

Therefore, a two-way collaboration mode from top-down and bottom-up shall be established. The top priority is to fully consider the actual needs and business application scenarios in the top-down design. The implementation plan after top-down design should aim at achieving the two-way collaboration of the top-down design constraints + infrastructure construction" and bottom-up scenario applications + satisfaction of demands.

3.2 Restructuring Construction and Implementation: Demand-oriented Scenario-driven Mode

Smart city construction features great input and long duration. Actually, smart city has no definite boundary to a great extent as technologies advance and human being's demands increase. The application scenario-driven new smart city construction refers to rapidly integrating specific demands with the overall design and basic support to solve problems, make key breakthroughs, promote work in all areas by drawing upon the experience gained on key points, and achieve collaborative development. Take COVID-19 prevention and control as example, at the very beginning, communities faced great challenges brought by numerous people and countless sheets, which made their work even more difficult. However, after ministerial representatives called for development of relevant software, all these challenges can be tackled rapidly by means of "Health QR Code" and AI technologies. Why we failed to make preparations in advance with such mature technologies? This may be partially attributable to the impetus for commercial application, but the key is lacking of scenario-based preparation.

During the smart city construction, we should convert demands into standardized scenarios with the minimum granularity considering the actual demands in accordance with the two-way collaboration principle under the context of top-down design. In this research, a "Panoramic Standardized Scenario Matrix" is designed

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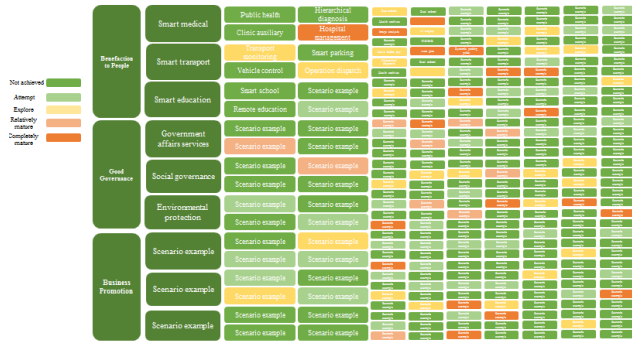ICEME '20, July 15–17, 2020, Beijing, China

Figure 1: Panoramic Standardized Scenario Matrix

by referring to the practical experience gained in multiple places. The model takes the following factors into consideration: actual demand intensity, technology maturity and success degree of application cases.1 is a sample diagram.

3.3 Restructuring Effect Assessment: Public Perception and Satisfaction-oriented Mode

Urban construction ultimately serves people, so does the smart city. In the assessment of smart city construction across the globe, we often get to know "what we construct", i.e. we mainly assess urban management institutions or service providers. The problem is what we assess is often property rather than people related thereto, and management rather than actual services. As a result, no assessment is made from the public's sense and satisfaction. The key is to draw the attention of those who build smart city to actual application and people's demands with the help of public assessment.

Undoubtedly, in the assessment putting people in the first place, the partial interests of the public and overall benefit of the city must be balanced. The public's short-term aspiration and the city's long-term planning shall be kept consistent. The key is to improve the public assessment through scientific design for an "assessment-based smart city construction".

4 CONCLUSION AND SUGGESTIONS

In the new smart city construction, focus shall be placed on the actual effect of digital governance and efforts shall be made to solve the problems considering actual demands and scenarios. First, it is necessary to establish a more mature resource catalogue matching the normalized "demand scenario solution", which will help city managers to establish the concept of digital governance to a great extent. Second, the emergency management module construction of smart city command system shall be strengthened to make good preparations for emergency management events. Third, we should further empower grassroots organizations to strengthen smart community construction. Grass-roots organizations collect and contribute data, but less frequently use the data due to lack of effective data returned despite their strong capability. Last but not the least, efforts shall be made to strengthen the coordination of design, development, application and actual needs, implement

the smart city effect assessment, and strengthen the actual effect of "assessment-based smart city construction".

5 PROJECT SUPPORT

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