Deepening Xiong' an Smart City Development through Information Technology: Postprint

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Date: 2017-11-17T00:00:00+00:00

Abstract

Through an analysis of the current development status and case studies of smart cities both domestically and internationally, and by drawing upon the specific practices of smart city development in Shanghai' s Lingang area, this paper proposes a construction framework for "Smart Xiong' an" that is perceivable, manageable, deducible, plannable, and replicable. It further presents an initial conceptualization of a distinctive smart city for Xiong' an New Area, with the urban comprehensive management platform as its core, the urban cloud data center as its key component, the overall basic service system as its support, and intelligent and refined urban development as its objective.

Full Text

Smart City Construction for Xiongan New Area: Significance and Strategic Approach

The Significance of Smart City Development for Xiongan New Area

The concept of "smart city"emerged from IBM's 2008 "Smarter Planet"initiative, though no unified definition has yet gained international consensus. Among the earliest systematic treatments of the topic is the October 2007 report *Smart Cities: Ranking of European Medium-Sized Cities* by Rudolf Giffinger' s team at the Vienna University of Technology [2]. On April 19, 2016, President Xi Jinping introduced the concept of the "new-type smart city" at the National Cybersecurity and Informatization Work Conference, articulating a vision that is "people-centered, delivering convenient public services, precise social governance, green socio-economic development, integrated urban-rural development, and controllable cybersecurity" [3].

International and Domestic Smart City Case Studies

United States. In September 2015, the U.S. federal government launched the *White House Smart Cities Initiative* [4], committing at least $160 million in federal research funding and establishing over 25 new technology partnerships to help local communities address critical challenges such as traffic congestion, crime, economic growth, climate change impacts, and urban service delivery. Key focus areas include: (1) creating testbeds for IoT applications and developing new cross-sector collaboration models; (2) partnering with civic technology initiatives to foster inter-city cooperation; and (3) laying a solid foundation for smart city construction through research and investment in sensor networks, cybersecurity, broadband infrastructure, and intelligent transportation systems.

European Union. The EU launched the Living Lab program for Innovation 2.0 in the knowledge society [5], aiming to transform cities into open innovation spaces that cultivate urban ecosystems conducive to innovation emergence. Using Living Labs as vehicles to drive smart city development, the EU evaluates urban systems across six dimensions: smart economy, smart mobility, smart environment, smart people, smart living, and smart governance.

Germany. Germany' s smart city concept [6] places greater emphasis on energy conservation, efficiency, and transition. Consequently, German smart cities prioritize city-specific interests: (1) The Leipzig Charter emphasizes that smart city development discourse should not be monopolized by large corporations; instead, planning and goal-setting should align with citizens' needs and adapt to each city' s unique characteristics. (2) The key to a smart city lies in the sustainability of the entire system, particularly regarding energy consumption —software alone is insufficient. (3) Germans reject fully digital "surveillance" models and do not want all information controlled by a single enterprise; cities themselves should retain greater autonomy. Therefore, Germany' s approach emphasizes universal participation in management through an open platform.

Netherlands. The Netherlands distinguishes itself by integrating smart living with arts and culture [7]. Key practices include human-centered design principles, human life driven by the knowledge economy, and data society rights and privacy protection. In Rotterdam' s smart city pilot project, various sensors, RFID technology, and the internet are combined to form an intelligent system. Located in the delta region, Rotterdam has built an "AI city" marked by water management innovations such as "water plazas."

China. Since China' s urbanization rate first exceeded 50% in 2011, various urban problems have become increasingly prominent, prompting consensus on the need to transform urban development patterns [8]. Since 2011, a few eastern cities such as Shanghai, Ningbo, and Guangzhou have pioneered smart city planning and construction, focusing on public services like healthcare, transportation, education, and wellness. In 2012, Beijing, Tianjin, Jiangsu, Hubei, Liaoning, and Hunan joined the smart city movement, applying intelligent and digital information technology to urban governance, finance, tourism, and other

domains. In 2013, the national smart city pilot list covered most provinces, marking the nationwide rollout of smart city construction. By the end of 2015, smart city concepts and plans had been implemented in over 80% of prefecture-level cities, with many county-level cities and towns also developing local smart city plans.

Current challenges in China' s smart city development primarily include: inadequate information integration and sharing exacerbating the "digital divide," single-actor participation inhibiting process improvement, and lack of market-oriented management mechanisms resulting in unclear government positioning.

Shanghai Lingang: A Practical Model for Smart City Development

In October 2003, the Shanghai Urban Planning and Design Research Institute compiled the *Lingang New City Master Plan.* On January 20, 2004, the Shanghai Municipal Government approved this plan (Document No. [2004]5), establishing Lingang New City as a critical component of Shanghai' s international shipping center. According to the master plan and relying on the Yangshan International Deep-Water Hub Port and Pudong International Aviation Hub, Lingang was to be built into a comprehensive coastal new city with highly coordinated social, economic, cultural, and ecological environments—functionally complete, vibrant, and strategically important as a subsidiary city. It would become a key industrial base centered on modern equipment manufacturing.

Over just a decade, Lingang New City, located at the intersection of the Yangtze River estuary and Hangzhou Bay in southeastern Shanghai, has simultaneously pursued two strategic goals: building a globally influential science and technology innovation center, a national new industrialization demonstration base, and a strategic emerging industry demonstration zone; and promoting the dual-drive development concept of smart city and intelligent manufacturing to enhance the substantive connotation of a modern coastal city with integrated functions and production-city fusion.

Lingang Smart City System Architecture. Based on full alignment with national, Shanghai municipal, and Pudong New Area "13th Five-Year" smart city plans, Lingang formulated its *Three-Year Development Plan Outline for Smart City Construction (2017–2019).* This plan aims to establish the smart city framework through top-level design and deployment, significantly enhancing urban digitalization, networking, and intelligence levels [Figure 1: see original paper]. Lingang aims to become, by 2020, an internationally leading small-to-medium-sized smart city model characterized by ubiquity, integration, and intelligent agility—achieving the goals of being "perceivable, manageable, deducible, plannable, and replicable."

The Lingang smart city system focuses on information infrastructure, information perception, intelligent applications, and regional demonstrations. It prioritizes deployment in key areas including network foundations, smart urban management, smart government, smart transportation, smart construction

management, smart parks, smart tourism, and smart livelihood services. The overall framework follows a "1234 N" architecture: 1 center—Smart City Operations Management Center; 2 platforms—high-speed information network and urban big data platform; 3 views— "Sky," "Earth," and "People" urban operation situation maps; 4 application domains—construction management, government affairs, livelihood services, and industry; and N (multiple) key implementation areas.

Building a Distinctive Smart Xiongan with Information Technology

(1) "One City Map, Decision Cockpit." In developing its distinctive smart city, Xiongan should meet the requirements of "big data support, intelligent decision-making, panoramic presentation, and flattened command." This will enable the future Xiongan Smart City Operations Management Center to handle daily grid management, support leadership decision-making, and present public image. The center should integrate controllable urban management personnel, public security, firefighting, medical, transportation, and vertically-managed departmental emergency safety information systems and data to achieve unified decision-making and command issuance for urban emergencies, ensuring interdepartmental coordination and enhancing Xiongan' s urban emergency response capabilities. The ultimate goal is to realize the "One City Map, Decision Cockpit" objective.

(2) Thematic, Networked, and Three-Dimensional Urban Planning Information Resources. Urban planning information data applications are growing increasingly rich, evolving toward dynamic, multi-objective, and intelligent models. Using information technology to thematize, network, and render urban planning information resources in three dimensions—moving from auxiliary approval to auxiliary decision-making—represents a comprehensive technology for planning informatization. Based on a geographic spatial information (GIS) platform integrated with Xiongan's existing and future diversified communications, satellite remote sensing, unmanned aerial vehicles, and building information modeling (BIM) technologies, the system will achieve platform and data fusion through multi-source technology integration. This enables shared access with other public data, various application domain engineering data, and third-party data, satisfying management and sharing needs among different users in Xiongan New Area at both breadth and depth.

From three-dimensional perspectives of "Sky" (environmental indices and energy consumption), "Earth"(virtual city sandbox), and "People"(fine-grained profiling and migration distribution), Xiongan should comprehensively construct basic urban operation situation maps to scientifically enhance urban governance.

- **Sky View:** By collecting water indices, meteorological indices, and other environmental data, the system establishes logical relationships between energy consumption and population, and between energy consumption and GDP. This enables smart applications such as environmental threshold

warnings and emergency response plans for major environmental events.

- **Earth View:** Based on GIS+BIM data fusion display, the system builds a three-dimensional virtual city with object-oriented management and presentation. Historical imagery data demonstrates urban development and changes; the virtual city sandbox enables object-oriented and refined management above ground, underground, inside buildings, and outside buildings. This supports smart applications including landscape landmark management, security planning, urban planning, emergency evacuation, airflow simulation, and business district analysis.
- **People View:** Using mobile location-based services (LBS) for fine-grained tagging data, the system constructs a refined urban operation system based on people tags. Through big data analysis of dynamic changes in people profiling, traffic flow, and video surveillance, smart applications can be developed for new area population profiling, new GDP contributions, work efficiency, permanent residents' GDP contributions, event/tourism impact, urban vitality indices, and transportation planning.

(3) Aerospace Remote Sensing. Utilizing advanced 3S technologies (RS—remote sensing, GIS—geographic information systems, GPS—global positioning systems), an integrated air-space-ground-ocean remote sensing network can dynamically and accurately grasp comprehensive urban development conditions. This includes urban expansion, port and road construction, land subsidence, and nearshore and water system ecological environments. The goal is to comprehensively clarify the "family assets," enable scientific planning and dynamic management, and facilitate rapid response to major events. Service applications will include but not be limited to: overall land use planning and dynamic control for urban construction, sponge city dynamic monitoring and evaluation systems, nearshore and water environment monitoring, and integrated air-space-ground-ocean remote sensing information platforms.

(4) Smart Transportation. For intelligent transportation demonstration cities, starting from data to build an urban brain, data analysis and processing can form various smart transportation application scenarios, achieving data-driven transportation operation, organizational optimization, and travel chain services. Fully utilizing advanced technologies such as the BeiDou system, intelligent control networks, cloud computing, and big data, the system organizes, optimizes, and mines traffic information for people, vehicles, and roads, enabling comprehensive transportation monitoring and prediction across time and space.

(5) Safe Production. A safe production management platform monitors all production and living behaviors of enterprises and residents within the region. Guided by systems theory, control theory, and information theory, the platform integrates "major hazard source monitoring systems, risk prevention and emergency rescue systems, and accident hazard investigation and treatment systems,"covering the full cycle of "pre-event prevention, daily supervision, in-event

emergency response, and post-event handling."

Key Implementation Paths and Measures for Building Smart Xiongan New City

Smart Xiongan construction is a complex systematic engineering project. During implementation, it is essential to grasp the importance and rhythm of various projects. Breakthroughs can be achieved in key areas first, using the practical results of critical projects to enhance confidence among all stakeholders.

(1) Leveraging Population and Legal Entity Database Projects to Build an Integrated Service System Benefiting Enterprises and Citizens. Taking enterprise and citizen services as entry points, efforts should focus on collecting, integrating, and sharing public data resources. Gradually upgrading and improving the population database and legal entity database will enable construction of a "Population Life Tree" and "Legal Entity Life Tree." Deeply mining and utilizing existing data resources and services will provide basic data services for government departments, allowing all departments to enjoy the convenience of data sharing, maximizing the effectiveness of existing achievements, and improving fiscal resource utilization efficiency.

(2) Using Perceivable Xiongan and Visible Xiongan Projects to Explore New Social Capital Investment Models. Wireless broadband and video surveillance transmission networks are critical components of information infrastructure requiring substantial capital investment and professional operation and maintenance teams, which pose difficulties for fiscal investment. Implementing wireless Xiongan and visible Xiongan projects can establish stable revenue models through social capital investment and market-oriented operation, minimizing one-time fiscal investment and improving informatization construction efficiency.

(3) Relying on the Smart City Development Center to Build an Efficient Management System. Using the smart city development center as a lever to promote data sharing and exchange platform construction can enhance information resource utilization efficiency. Building an urban operation management platform improves urban collaborative management and operation levels. Through dual integration of hardware facilities and soft environment, the center creates an information carrier for urban management and establishes a new benchmark for innovative urban management thinking and efficiency improvement.

(4) Guiding with Smart Township Pilots to Promote Coordinated Beijing-Tianjin-Hebei Integration. Comprehensively promoting smart township construction across all districts and plates in the new area—using point-to-area demonstration to achieve full coverage—will make smart township construction a new highlight for coordinated development between Xiongan New Area and the Beijing-Tianjin-Hebei region.

Organizational and Policy Measures

To embody the core connotation of Xiongan' s distinctive smart city and implement development goals and main tasks, measures must be strengthened in organization, policy, funding, talent, and publicity to ensure smooth implementation of all Smart Xiongan projects.

(1) Strengthening Coordinated Planning. Coordinate Smart Xiongan construction with national master planning. Under the overall planning framework, promote smart city application project construction in a coordinated manner, forming a leadership mechanism with unified direction, rational division of labor, clear responsibilities, and smooth operation. Rely on domestic and international smart city intellectual resources to establish a Smart City Expert Committee, providing important support for more scientific and international smart city construction. Form an expert consultation team to strengthen strategic research and top-level design.

(2) Establishing Standards and Norms. Strengthen reform and innovation of operation models, business processes, and standards related to smart city construction. Standardize data resource collaboration and sharing processes, and regulate informatization project construction, operation, and management. Enhance standards research and formulation, actively participate in national smart city standards development, and advance demonstration, verification, and evaluation of national smart city standards in Xiongan New Area to form a leading new-type smart city standards system.

(3) Establishing Evaluation Mechanisms. Establish a scientific and rational smart city construction performance evaluation index system to promote continuous improvement of Smart Xiongan construction. Strengthen evaluation and assessment of smart city application project progress, quality, and effectiveness to ensure major projects achieve expected results. Standardize project management, strengthen scheme design and scientific demonstration for major projects, enhance project approval management, and strengthen supervision of project progress and funds.

(4) Guiding Social Participation. Emphasize publicity and education to enhance resident participation in Smart Xiongan projects. Using smart city informatization as an entry point, fully utilize social platforms, the internet, and various media to guide citizen participation in Smart Xiongan construction, strengthen public opinion guidance for smart city construction, and create a strong atmosphere for smart city development, enhancing citizens' sense of happiness and gain.

Acknowledgments

The research and implementation of the "Smart Lingang Application Demonstration Based on BIM+GIS Urban Big Data Computing Platform" and "Lingang Smart City Remote Sensing Information Application and Service System"

projects are supported by the Shanghai Lingang Area Development and Construction Management Committee. We thank the Shanghai Urban Public Safety Research Center and Shanghai Pudong Lingang Smart City Development Center for their significant assistance.

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Note: Figure translations are in progress. See original paper for figures.