The construction and management of industrial park digitalization and its application services

Jianfang Zong¹, Liang Chen¹, Quansheng Li², Zhenzhen Liu²

¹China National Institute of Standardization, No.4 Zhichun Road, Haidian District, Beijing, China
²Tus-digital Group, Beijing, 100084)
zongjf@enis.gov.cn

Abstract. This paper introduces the current situation of industrial park digitalization standards and the construction of park digitalization, expounds the principals of digital construction of industrial parks and the digital construction contents of industrial parks, including construction requirements such as perception layer, transmission layer, platform layer, application layer, safety and security, operation and maintenance. This paper also discusses the application services for industrial park digitalization including operation service, property service, corporate service and life service, and explains the management of park digitalization such as safety and security of industrial park digitalization.

1. Introduction
Park digitalization utilizes information and communication technologies to detect, analyze and integrate various key information concerning the core system of city operation to make intelligent responses to the needs in all kinds of areas ranging from people’s livelihood, environmental protection, public security, city services to industrial and commercial activities. The average growth rate of industrial enterprises above designated size reached 11% and the total industrial output value increased by 23% from 1998 to 2008. The emergence of industrial parks speeds up the regional industrialization process and serves as the platform for industrial development, test ground for project implementation and incubator for private enterprises. The development of industrial parks has been carried out for more than 30 years since the establishment of Shekou Industrial Zone in 1979 and the digitalization is a natural and inevitable choice in the path to development. In particular, the rise of the Internet of Things, big data and cloud computing in recent years has prepared industrial parks well for digitalization. This paper aims at discussing the construction and management of industrial park digitalization and its application services.

The standard of park digitalization is established to allow the park digitalization to develop in a standardized and normalized way [1]. The main objectives are to set up a set of scientific and effective standard working bodies, management systems and operation mechanisms, build application systems relevant to park digitalization to promote readjustment and improvement of industrial structure within parks, create support systems for park digitalization to meet the needs of various resident enterprises for digitalized environment and design evaluation systems for park digitalization to improve supporting services of park digitalization. The establishment of park digitalization standard should be demand-oriented and guided by the scientific development philosophy. In addition, park digitalization standards so devised should be subject to integrated planning and design from a systemized
perspective and be supported mainly by mature technologies, reflect and incorporate advanced ideas and combine with actual situations and successful experiences so as to ensure reliable and effective operation of digitalization systems.

At the present stage, there is no specific governing specification and standard system regarding park digitalization in China\(^2\). However, a series of standards concerning park construction have been published, such as the Classification and Fundamental Requirements of Logistics Park and the Standard for Sector-specific Eco-industrial Parks (Fuchun Xu, Ding Liu, et al. 2008). In addition, standards relevant to construction, light current, information services and other aspects are in place, which lay a foundation for the study on park digitalization standard. Thus, the standards for park digitalization are increasingly needed (Yunfan Lu, 2007). First of all, the developers and construction units of industrial parks require standard systems of park digitalization to regulate their management and construction works. Secondly, various resident enterprises need such standard to guide their actions in the course of business operation. To sum up, it is an inevitable choice in the process of industrial park digitalization to make regulations concerning park construction and park management through a standardized approach and to develop a set of scientific and advanced standards for the construction and management of industrial park and to develop its application services.

2. Current status of industrial park digitalization

Currently, China has more than 15,000 industrial parks and the rate of contribution made by these industrial parks to China’s economy is above 30%. The number of national development zones was 219 in 2011 and 364 in 2015, suggesting an annual compound growth rate of 13.5%. The number of national development zones has been increased steadily after the rapid development period from 2012 to 2013. A total of 9 national development zones were approved in 2014, indicating a growth rate of 2.8%. However, the number of newly approved national development zones in 2015 was increased by 9.3% to 31. By the end of 2015, there were 145 national high-tech zones and 219 national economic development zones\(^3\).

Industrial parks play a significant role in promoting innovative development. Although the total coverage of industrial parks accounts for less than 1% of the territory, the R&D investment made by national high-tech zones alone took up 39.7% of the total R&D investment made by Chinese enterprises as a whole in 2015. Furthermore, the sales of innovative products of national high-tech zones in that year accounted for 32.8% of the total sales of innovative products of all Chinese enterprises. The majority of China’s industrial parks require upgrading and transformation.

There are some widespread problems existed in industrial park management and industrial cluster cultivation in China:

Firstly, the industrial park development orientation is unclear. There is a large discrepancy between the industry orientation of the park and the local situations such as development foundation, technical capabilities, talent resources and industrial structures. In addition, many kinds of industries huddled in one single park with generally short industry chain and poor link.

Secondly, the parks are confronted by challenges in terms of comprehensive management. The management techniques utilized by parks are backward; the information services and the support to enterprise application provided by parks are limited; the methods of energy saving and the full-coverage surveillance are in shortage; the system information is isolated to a great extent and the attempt to build an effective connection has failed.

Thirdly, the parks are confronted by challenges in terms of development. The industrial supporting services are inadequate; the supportive policies aiming at promoting innovative development of enterprises are not competitive enough; and the absence of coordination between resident enterprises prevents the park from developing cluster competitiveness.

Last but not least, the parks are confronted by challenges in terms of sustainable development. There is serious input-output imbalance, making it difficult for parks to attract talents, technologies and funds.
To overcome these challenges, industrial parks are in urgent need of transformation and upgrading. Some significant background information regarding the industrial park development should be taken into consideration in exploring the ways the industrial parks may use to achieve harmony between human, enterprises, industrial parks and cities and sustainable development in the process of new industrialization and urbanization.

The era of digital economy is coming. From the original agricultural economy to the industrial economy and to the digital economy, the industrial structure is ever changing. Currently, high-tech industries act as the backbone of the society; innovations become the core of the industrial and enterprise development and intellectual resources provide the main support. The forms and the contents of industrial parks are at the time of changing.

The macro-economic situation in China is changing. China's economic development has entered a 'new normal' and we must promote changes and reformation at the supply side. Measures such as destocking and de-capacity will have a significant impact on the construction and development of industrial parks.

The operation mode of industrial parks is facing reconstruction. The operation mode of industrial parks has undergone a series of dramatic changes under the new market environment, reflected in gradual maturity of capital market, expansion of industrial chains within parks and improvement of professional park operation and management. These changes, combined with the mode of Internet+, bring about fundamental transformation of overall park operation and management.

Park digitalization is critical to compete over high-end industrial development elements, speed up self-dependent innovation of technologies, promote industrial transformation and upgrading, improve systems for livelihood protection and create unique park-specific brands. Along with the rapid development of Internet, Internet of Things, big data, cloud computing and artificial intelligence, the digital information has become more and more widespread, thorough and intelligent. Under such circumstances, how can digital information support the development strategies, meet the demands from the core business, and promote comprehensive and sustainable development of industrial parks? These are the common tasks to be tackled by China’s industrial parks.

3. Principles of park digitalization

Four principles apply to the digital construction of industrial parks, namely the principle of standardization, the principle of integration, the principle of applicability and the principle of advancement. The principle of standardization requires the digital construction of industrial parks to work out top-level requirements based on actual needs and guarantee scientific planning and orderly development of digital construction through standardization. The principle of integration requires enhanced integration of information technologies, overall planning and scientific instruction to prevent classified information systems from turning into information isolated islands and to promote coordinated development of information construction of industrial parks. The principle of applicability requires the digital construction of industrial parks to adjust measures to local conditions and take functional orientation, development needs, geographic conditions and information development basis in construction and operation to use applicable information technologies to facilitate the development of park digitalization. The principle of advancement requires the digital construction of industrial parks to encourage parks and resident enterprises to adopt advanced management philosophy, advanced methods and advanced technologies so as to ensure the digitalization is highly integrated, perfectly flexible and fairly secure with good manageability, maintainability, expandability and evolubility.

4. Framework of the construction of industrial park digitalization

The construction of industrial park digitalization is carried out at four layers. Requirements are imposed accordingly; firm support is provided based on security assurance and institutional assurance and sustainable development is promoted through operation and management service.
4.1. Perception layer
The perception layer refers to the data collection and automation control layer of digitalized parks, covering environment, energy, building, transportation, security and safety.

4.2. Transmission layer
The transmission layer refers to the data transmission and exchange layer of digitalized parks and supports the information transmission network connecting digital application systems and various IntelliSense systems, including premises network, mobile communication network, wireless local area network, Narrow band IoT, etc.

4.3. Supporting layer
The supporting layer refers to the layer supporting centralized data storage and application of digitalized parks and includes information resources integration platform, cloud resources management platform, big data mining and analysis platform, information resources sharing platform, application services integration platform and uniform service interface.

4.4. Application layer
The application layer refers to the layer providing digitalization services and has three functional modules, i.e. Command Center of Park Operation, Intelligent Call Center and Digital Display Center. Four kinds of application software services are covered, including park operation, property management services, corporate services and life-support services.

4.5. Security and institutional assurance
The security and institutional assurance serves as the foundation and supports park operation. Security assurance and institutional assurance are covered.

4.6. Operation and management service
The operation and management service specifies the responsibilities, contents, processes and supervision of sustainable operation of parks and has two components, namely operation and management service.

5. Application services of industrial park digitalization

5.1. Operation service
Operation service provides a diverse range of access points and all-around operation services for enterprises and employees in the parks. Its main functions should include:

5.1.1 Network cloud service. Build and operate a public service platform for enterprises and individuals in the park to provide full-service for SaaS service providers. Operation services should include: cloud-based service operation providing basic cloud rental services, such as cloud hosting, cloud desktop, cloud disk, virtual data center, container services, collaborative development and Open API; SaaS Operation Service; APP Store; and space operation service to make full use of digital showrooms and free space resources, providing reservation and rental services, and demonstration services.

5.1.2 Big data service. Organize and integrate different industries in the park, and provide a complete product system for the planning, decision-making, supervision, and servicing of these industries. Big data services should include: collection of data related to industrial big data, including basic data in various fields, domestic and foreign industrial development information, industrial chain development data, regional economic data, corporate data, subject matter data, and supporting data; general supporting platform services for industrial big data; and various types of software services for users such as all levels of government, parks, and enterprises.
5.1.3 Investment management. Manage the entire life cycle of investment promotion activities, with main functions including customer management, investment contract management, and rent management.

5.1.4 Policy approval. Provide administrative approval for the parks, corporate e-taxation, construction project marketing and government affairs management services to support different levels of administration such as macro-control, market supervision, social management, and public services, and provide interfaces for e-government system in the cities.

5.1.5 Consulting service. Provide information consulting services about various fiscal policies, regulations, park services and development trends, public utilities, and public utilities.

5.1.6 Financial service. Provide various financial related services, such as fund investment and financing.

5.1.7 Information release. Online release management of dynamic information in the parks, such as related information, news, information on-the-fly, and industrial policy trends. It is advisable to install display screens for information distribution in the main entrance and exit of the park, and set up touch screens in the lobby at the first floor of the main building to serve as information query and guidance multimedia tools. It should be able to display the same contents on all the terminals, but also show information independently at every release point through single-point management.

5.1.8 Emergency management. Respond to emergencies such as security events and natural disasters in the parks, and to improve emergency readiness, rescue and support capabilities. Its main functions should include emergency events positioning, emergency facilities dispatching and management, and emergency plans management. Loudspeakers should be deployed in public areas and smart buildings in the park, and linked to fire alarm systems. The emergency broadcasting system should comply with the provisions of GB/T 50314-2006 [9].

5.2 Property service
Property service is based on the daily property business management. Focusing on customers (owners, tenants, and households), it effectively integrates various businesses in the property management process, realizes the management and control of the core business by the property management company, reinforces the management standards of companies, improves corporate management efficiency, and ultimately achieves more economic benefits. Its main functions should include:

5.2.1 Integrated property management. Through the application of mobile internet, Internet of Things, and modern smart handheld devices, manages the maintenance and update of the park's resources. Its main functions should include: patrolling inspection, malfunction reporting, taking orders, foreign personnel check-in services, cleaning and green plant management, asset management, and equipment operation status management.

5.2.2 Integrated environmental management. Run comprehensive management of water quality, air quality and noise in the park. Its main functions should include environmental monitoring, information release, alarm management and information analysis.

5.2.3 Integrated energy management. Run comprehensive management and optimal control of production capacity, energy transmission and energy use in the park. Its main functions should include the planning of different forms of energy, such as electricity, natural gas and new energy; refined measurements based on categories, levels and regions to classify energy consumptions in the park; measurement and analysis of energy consumption information collected by the system; comprehensive
dispatch of different forms of energy such as electricity, natural gas and new energy; optimization of energy use strategies; and energy consumption analysis.

5.2.4 New energy management. Deploy distributed power sources, energy storage devices, energy conversion devices, and related loads, monitoring and protection devices of the new energy power generation and distribution system based on the planning of power grid inside the park and the deployment of new energy sources, such as solar and wind energy. Realize distributed power supply by using renewable green clean energy, and as a result, improve reliability of power supply and efficiency of energy utilization, and reduce carbon dioxide emissions.

5.2.5 Intelligent traffic parking. Integrate advanced information and communication technology into the transportation, parking and charging management systems in the park. Its main functions should include traffic information services, traffic management, public transportation, vehicle control, electronic charging, smart parking, intelligent lighting and smart charging piles for new energy vehicles.

Smart parking utilizes hand-held terminals and wireless geomagnetic sensing devices to ensure safe and effective management of roadside parking spaces, including charging fees, personnel management, parking space management, safety supervision and parking guidance. At the same time, it is linked with multiple platforms such as the external third payment platforms and municipal or district traffic information centers. Intelligent lighting realizes remote single light switch, dimming, detection and other control functions by using a variety of Internet of Things and information technology.

Smart charging piles should integrate multiple functions including security prevention, environmental monitoring, lighting, WIFI base station, and media advertising. As to parking lots for public or industrial buildings in the park, and public parking lots for independent land-use, the proportion of parking spaces with charging facilities or with reserved room for construction and installation of charging facilities should not be less than 10% in principle. Parking spaces for all residential buildings should be equipped with charging facilities, or set aside installation conditions. An operating lease network for pure electric vehicles by the hour is established.

5.2.6 Building automation management. The building automation system should comply with the provisions of GB/T 50314-2006[^9]. The system should unify communication protocols and interfaces between various electromechanical subsystems; the monitoring and management for the operation status of the mechanical and electrical equipment of each building in the parks should be realized based on the construction scale of the parks.

Management of smart stadiums should be implemented through the application of Internet of Things and mobile internet technology, to control lighting on the site and other equipment automatically; with the aid of wearable devices, Hawkeye cameras and other sensing devices, collect the sports data of field athletes for exercise and health analysis; provide online booking, appointment to play, payment, live broadcast, quiz, online communication and other functions as well.

5.2.7 Geo-information management. It is the information management for the geographical layout of facilities in the park. Its main functions should include: facility classification, image archive management, additional record information management, graphic display facility management, facilities and equipment development plans, facility query and positioning, comprehensive inquiry into facilities and statistics.

5.2.8 Security control system. The security control system should comply with the provisions of GB 50348-2004[^10]. The system should meet the following requirements: deploy intelligent video sensors in buildings and public areas of the parks, and use infrasound pressure, pan-infrared, vibration, acceleration and other sensor technologies;
Video surveillance systems should be deployed at least in public areas such as main entrances and exits, intersections and surrounding areas of the parks, main entrances and exits on the first floor of buildings, fire exits, entrance halls, elevator cars, machine rooms and catering service areas;

An intrusion detection alarm device should be installed in the perimeter of the parks. Non-shielded perimeters should apply buried intrusion detection systems. For shielded perimeters, electronic fence systems should be deployed, and intrusion detection alarm devices should be installed around the first to second floors of the buildings. Electronic patrols should be installed at the bottom and top of the buildings;

The linkage control technology should be integrated to build the linkage between security subsystems such as video surveillance, anti-theft alarm, perimeter alarm, electronic patrol, and electronic access control, and it should be used in conjunction with other systems (i.e. information distribution, radio, television, etc.).

5.3. Corporate service
Based on cloud computing, corporate service aims to fully meet the diversified and comprehensive needs of enterprise management and development, and provide related enterprise services. Its main functions should include:

5.3.1 Conference service. Corresponding conference service equipment should be configured according to different conference venues. Simultaneous interpretation systems should be configured for large conference centers and remote video conference access systems should be configured in professional conference rooms. For a conference center with a large number of conference rooms, central management devices for conference rooms should be considered.

5.3.2 Office service. Provide digital management applications for enterprises to improve office efficiency. Its main functions should include daily administrative management, approval transfer, personal office, office document management, collaborative office, online communication, and information release.

5.3.3 Human service. Apply information technology to provide enterprises with human resources management services. Its main functions should include: talent demand services of the parks, talent outsourcing services of the parks, talent dynamics management, entrepreneurship tutoring, talent training and talent investment.

5.3.4 Financial service. Apply information technology to provide financial services for enterprises. Its main functions should include: tax preference, granting of special funds, listing financing services, and credit system services.

5.4. Life service
Centered on “residents in the parks”, and focusing on everyday life in the parks, life service provides all-round life services for employees and other individual users in the parks. Its main functions should include:

5.4.1 All pass card. Manage the smart card services for employees and enterprises that bases their business in the park. By using a unique card number, multiple functions of different cards (including park service card, company employee card, parking card, bank card, and consumer card) are integrated into this one single card.

The all pass card, as a medium for identification and payment verification of enterprises in the park, should exercise main functions including entrance and exit of persons and vehicles into and from park gates, canteen dining, supermarket shopping, office entrance and exit, personnel attendance, visitor
registration, shuttle ride, domestic water supply, self-service, and parking, and through standard third-party interface specifications, realize connection, integration and data sharing with related systems.

5.4.2 E-commerce in the park. Use information technology to provide e-commerce shopping service for the park's consumers, create online e-commerce and offline life circle in the park.

5.4.3 O2O living platform. Build an online and offline life service platform to provide daily life services for the park's consumers. Its main functions should include food services, group purchase services, express delivery, travel transportation, financial services, and tourism services.

5.4.4 Social service. Provide online social services for individual users in the park, such as live chat, group chat, and live broadcast.

6. Safety and security of park digitalization

6.1. Goal
A comprehensive safety and security system should be built for park digitalization. To build such a system, we need to set up information organization, develop corresponding systems, make budget and use plan of funds and work out security requirements for park digitalization, requirements for operation and maintenance supports and quality management requirements.

6.2. Safety requirements
Comprehensive information safety architecture covering safety requirements for various aspects such as physical safety, cyber safety, host safety, application safety, data safety, backup and recovery and safety management should be developed for park digitalization in accordance with relevant provisions set forth in GB 17859[4], GB/T 20269[5], GB/T 20270[6], GB/T 20271[7] and GB/T 22239[8].

6.3. Security requirements
The security requirements for park digitalization include but not limited to requirements for human resources management, asset management, security incident management, access control permission management, data management and daily work management. Infrastructure and information platform of park digitalization, application system as well as personnel for construction, operation and maintenance are preferred to be covered by the security system and risk assessment, monitoring and warning system, security governance, emergency response and back and restoration are the ideal components of the security system of park digitalization.

6.4. Assessment and evaluation
A comprehensive information management system should be developed for park digitalization, which covers fields such as park planning, park construction and park operation and maintenance. If possible, industrial parks should get certified under appropriate systems in accordance with GB/T 19001[11], GB/T 22080[12], GB/T 24001[13] and GB/T 28001[14]. In addition, regular evaluation should be organized during digital construction and management of industrial parks to promote continuous improvement of park digitalization.

7. Conclusion
On one hand, the construction and management of industrial parks digitalization and its application services in China have been developed rapidly, but on the other hand, there are still many prevalent problems and challenges that need to be addressed in the path to park digitalization. A standardized method is required for regulation purpose to improve the management and services of park digitalization. Although special attention has been paid to the construction of industrial parks digitalization, a set of comprehensive, scientific and effective standard working bodies, management systems and operation mechanisms is yet to be established. The establishment of park digitalization
standard will contribute to the enhancement of comprehensive competitiveness of industrial parks, optimization of industrial structure, strengthening of sustainable development and facilitation of rapid development of park economy. It’s an inevitable requirement for park development as well as an irresistible trend of social and economic development.

References
[1] Mingrui Wang & Min Liu, Study on Park Informatization Standard System, Science and Technology Innovation Herald, 2010 (21), 101-101.
[2] Tianhui Sun, Study on Informatization Standard System of Industrial Park, The Business Times, 2012 (3), 128-129.
[3] Jianfang Zong, Quansheng Li, Zhenzheng Liu, General requirements for the construction of Industrial park digitalization, Standard Science, 2018(3), 42-46.
[4] GB/T 17859 Classified Criteria for Securing Protection of Computer Information System.
[5] GB/T 20269 Information Security Technology - Information System Security Management Requirements.
[6] GB/T 20270 Information Security Technology - Basic Security Techniques Requirement for Network.
[7] GB/T 20271 Information Security Technology - Common Security Techniques Requirement for Information System.
[8] GB/T 22239 Information Security Technology - Baseline for Classified Protection of Information System.
[9] GB/T 50314 Standard for Design of Intelligent Building.
[10] GB 50348 Technical Code for Engineering of Security and Protection System.
[11] GB/T 19001 Quality Management Systems - Requirements.
[12] GB/T 22080 Information technology - Security Techniques - Information Security Management Systems - Requirements.
[13] GB/T 24001 Environmental Management Systems - Requirements with Guidance for Use.
[14] GB/T 28001 Occupational health and safety management System Specification.