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Original Paper

Research on Intelligent Industrial Park Management System

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Abstract

In recent years, the scale of industrial parks in China has grown rapidly, but the use of intelligent management methods for industrial park management in China has not been carried out for a long time and lacks relevant experience. To explore the management mode and application characteristics of smart industrial parks, this article derives the operation mode of the smart industrial park management system based on the digital twin infrastructure, and elaborates and analyzes the main functions and characteristics of the smart industrial park management system, To provide reference and reference for better promoting the management system of smart industrial parks.

Keywords

industrial park, digital twin, management system

1. Introduction

At present, the scale of industrial parks in China is huge, and industrial agglomeration has the essential characteristics of spatial economy. It is a form of regional economic spatial organization and can effectively improve production efficiency. The important carrier of industrial agglomeration is industrial parks. As the main carrier for the development of industries and enterprises in China, industrial parks will gradually achieve intelligent governance in future management processes with the development of technologies such as the Internet of Things, geographic information systems, mathematical models, cloud computing, and various sensors, which can greatly promote regional economic growth (Feng, 2023). Zou Yingjiu proposed the concept of technology supporting park management in 2014 (Zhou, Lu, & Huang, 2014). In 2022, Meile et al. demonstrated the improvement of park decision-making, management efficiency, and control quality brought by the digital twin control system in the actual case of smart industrial parks in Foshan, Guangdong (Mei et al., 2023). With the continuous expansion and enrichment of industrial parks in China, more issues and practical cases of intelligent industrial parks have been brought. How to improve the efficiency of management and decision-making and enhance the

management value of industrial parks will be better solved by studying intelligent park decision-making and management systems. Smart industrial parks integrate the management thinking of Internet plus industrial parks, and combine the current digital twin system applications, Create a virtual model of park facilities in a digital manner, and strengthen the intelligent environment and management capabilities of park management through virtual and real interactive feedback, data fusion analysis, and decision iteration optimization. So that more relevant departments, enterprises, and research institutions can also participate in the construction of smart industrial parks. The digital management of industrial parks and the development and application of digital twin technologies provide a reliable way for intelligent management of industrial parks.

2. Smart Industrial Park Management System

2.1 Concept of Digital Twin System

The concept of digital twin started relatively late in China, and was first systematically introduced by scholars such as Tao Fei and the Beihang Digital Twin Technology Team. Based on the existing three-dimensional model of digital twin, they proposed a five dimensional model of digital twin, which is the connection between various components such as physical entities, virtual entities, twin platforms, and twin data. Based on this, a digital twin standard system has been systematically proposed. This marks a broader application space for digital twin systems. The digital twin Standard Model is shown in Figure 1.

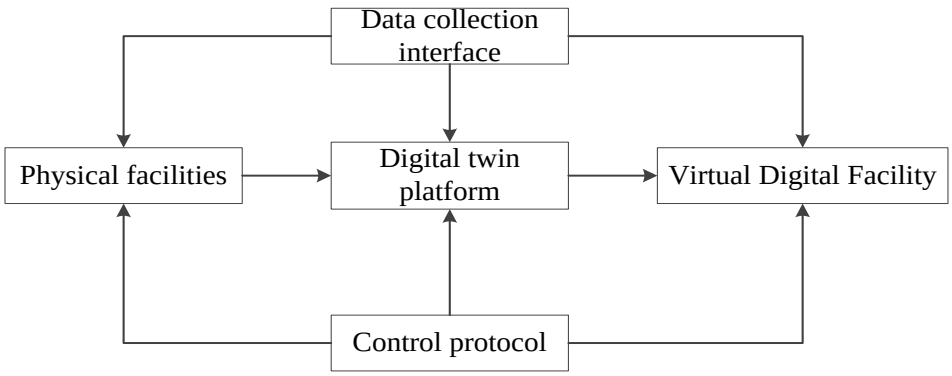

Figure 1. Digital Twin Framework

2.2 Construction of a Management System for Smart Industrial Parks

The smart industrial park connects and cooperates various infrastructure and virtual facilities in the industrial park through digital information technology, greatly improving the management efficiency and intelligence level of the industrial park. This article constructs a smart industrial park management system based on the digital twin system, which can gather thematic data and perceive the situation of park industries, security, asset management, park environment, energy consumption, etc. The purpose of the intelligent industrial park management system is to make the operation and management of the industrial

park more efficient. Based on previous research results, the intelligent industrial park management system should comprehensively use the new generation of information technology, such as automatic and remote monitoring technology, CIM technology, Internet of Things technology, Big data technology, cloud computing technology, artificial intelligence, etc., to integrate the buildings, landscapes, equipment pipelines Effective connection of infrastructure such as office equipment, through complete service functions to achieve automatic monitoring, real-time scheduling, scientific decision-making, network office, and standardized services of the industrial park management system, providing intelligent management models and services for the governance and maintenance of the industrial park.

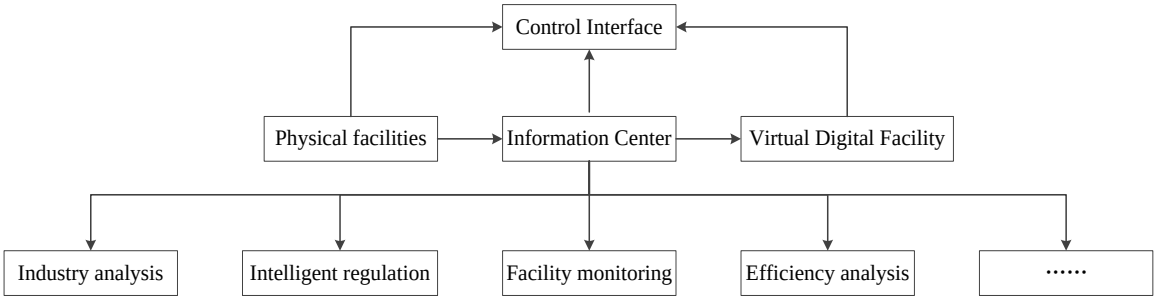

Figure 2. Framework Diagram of Smart Industrial Park Management System

2.3 Main Functions of the Smart Industrial Park Management System

2.3.1 Industrial Park Facility Monitoring

Industrial park facility monitoring is an important foundation for smart industrial parks, and its basic data monitoring and mastery are very important. Data is also the foundation for intelligent regulation, and it is also convenient for refined management. Therefore, more accurate data collection is required for the park. By arranging reasonable sensor distribution, a three-dimensional monitoring network combining "points, lines, and areas" is gradually formed for the park. The multi-dimensional analysis of the overall facility situation of the park includes the park air monitoring, floor Spatial analysis, park general layout analysis, floor electromechanical facility analysis, floor energy consumption monitoring, to achieve Big data driven park management. In combination with early warning information and data feedback, monitoring based on key nodes can build an intelligent management Decision model, which can specifically identify the key factors affecting the abnormal operation of the park.

2.3.2 Intelligent Regulation of Industrial Parks

By utilizing the virtual and real interaction system of digital twins, various physical and virtual facilities are organically connected through "sensor terminals, transmission networks, cloud computing centers, and application facilities". The online virtual facility control system is simulated, simulated, and optimized, thereby issuing instructions for offline air conditioning systems, parking lots, security cameras, rainwater and sewage drainage pipes, logistics gates, and other physical measures, and regulating unreasonable areas or equipment at park terminals, Accurately control various facilities, view the

distribution, content, and status of all monitoring points in real time, accurately locate identified sensor equipment fault points or data alarm points that exceed indicator thresholds, generate warning lists using basic data, and support feedback guidance for on-site maintenance. Simultaneously recording scheduling information and system scheduling operation information for disposal and management, facilitating tracking operations, improving quick response to emergencies, and rapid regulation.

2.3.3 Informationization Analysis of Business Layer

Informationization analysis is mainly applied to industrial analysis and investment analysis of smart parks. Load various infrastructure infrastructure indicators, use basic models for simulation, and conduct dynamic digital simulation to gather business data from various industrial chains in the park. Refine and analyze business data from various aspects such as overall industrial development, innovation driven development, industrial structure upgrading, and park enterprise management analysis of the park industry, achieve key data mining, and improve the efficiency of park industry management (Gu & Xia, 2023). Visualize and analyze existing business data such as existing investment plans, investment projects and investment analysis, so as to help the park effectively implement investment promotion, realize Big data visualization and accurate investment promotion, strengthen the cooperation of investment promotion in the park, and promote the transformation and upgrading of the park's industry in a flat way of communication, cooperation and management.

3. Characteristics of Smart Industrial Park Management System

The smart industrial park management system is a system engineering that requires the integration and collaborative work of multiple resources to provide various intelligent services for the industrial park in system management, thereby generating more efficient synergy in the operation process of the park. The management system of smart industrial parks not only relies on the consistent operation and maintenance characteristics of industrial parks, but also is interconnected with the new generation of information technology. This is one of the derivative products and development forms based on the construction of smart cities, which makes the management system of smart industrial parks have multiple characteristics. In summary, the smart industrial park management system has the following characteristics:

(1) High level of refined management. The smart industrial park management system combines modern information management means, including Big data, cloud computing, the Internet of Things, artificial intelligence and other new generation of information technology, and conforms to the most advanced equipment and facilities management philosophy. It should use GIS technology, sensor equipment to conduct all-round information and data collection for the park, and also use cloud computing technology to conduct simulation analysis and simulation, to ensure that real-time monitoring and dynamic management of the park can be achieved (Dai, 2023). Fully achieve the goal of online and efficient management of the park, comprehensively improve the level of refined management and assist decision-making in the park, efficiently and quickly carry out precise facility maintenance and achieve intelligent

control of facilities, and provide intelligent and personalized customized services for park managers, enterprises, and the public.

(2) The management system has high security. The security issue of digital twin technology is the primary research focus. Most industrial parks are located in key areas and locations of urban development, and some are also national major or confidential projects. When these facilities are combined with modern information technology, it is necessary to ensure the security of their operation and management, and China has introduced foreign technologies as support in many aspects such as high-tech, digital engines, servers, etc. To ensure the absolute security of data during the operation of the park, and to prevent information related to national security from being leaked, strengthen monitoring of the network and interfaces, and prevent illegal elements from invading the network system, To avoid situations where park management is out of control or hackers invade.

(3) The operation and maintenance costs are relatively high. To promote advanced technology and management concepts, efforts must be made to maximize cost effectiveness. In the current application process, smart industrial park management systems face high cost risks due to the complexity of sensors and system development. Compared to traditional park management, industrial parks alone have added a lot of content in the initial construction, During the operation period, according to different customer requirements and types of industrial parks, specialized business functions need to be developed separately, which directly increases the corresponding development investment. The smart industrial park management system also needs to continuously update and upgrade technology, and even involves some intellectual property fees, such as RFID tags for the Internet of Things and some energy consumption monitoring equipment. And it is also necessary to cultivate a new generation of intelligent industrial park management talents, which are additional costs.

4. Conclusion

In summary, the smart industrial park management system based on digital twin technology not only requires the support of IoT related technologies, but also combines real park facilities with virtual facilities to achieve virtual and real integration, utilize simulation and data mining, intelligently regulate park facilities, achieve visual management, build dynamic models, and integrate data information through intelligent means, Continuously enhance the refined management capabilities of the park, achieve quality and efficiency improvement in park management, and achieve sustainable development of the city.

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