The Application of Digital Platform in the Digital Transformation of Construction Industry——Case study of China Huashi Enterprises Co., Ltd

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Abstract. Digital economy has become the main economic form at present. It takes data as a key factor of production and forms economies of scale through data utilization and sharing. The digital economy promotes economic and social development by promoting the transformation of economic structure and improving labor productivity. As a mainstay industry of national economy, construction industry actively carries out digital transformation is the key to enhance its competitiveness. This paper takes the "Shanjian Cloud" digital platform of China Huashi Enterprises company limited as an example. Based on the problems of digitization in construction industry, this paper provides a path of digital platform construction, and analyses the architecture design, specific application and practical effect of the cloud platform. Finally, it gives some suggestions on future development. The purpose of this paper is to provide ideas for construction enterprises to build digital platforms and realize digital transformation at the group level.

Keywords: digital economy; digital platform; construction industry; digital transformation; information system

1 Introduction

In recent years, the CPC Central Committee, The State Council and governments at all levels have put forward specific and clear requirements for digital construction. In May 2020, the National Development and Reform Commission issued the initiative of "Digital Transformation Partnership Action", proposing to build a digital industrial chain. August of the same year, The Ministry of Housing and Urban-Rural Development issued the Guidelines on Promoting the Coordinated Development of Smart Construction and Building Industrialization.It is pointed out to accelerate the industrialization, digitization and intelligent upgrading of buildings, accelerate the transformation of construction methods, and promote the high-quality development of the construction industry. In December 2020, the Ministry of Industry and Information Technology issued the Industrial Internet Innovation and Development Action Plan, pointing out that efforts should be made to solve difficult problems in the development of the industrial Internet and promote industrial digitization. In January 2022, The State Council issued the 14th Five-Year Plan for Digital Economy Development, deploying key work to promote industrial digital transformation. In October of the same year, The State Council's report on economic development pointed out that on the basis of strengthening digital infrastructure, we should

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continuously promote the high-quality development of China's digital economy. Therefore, the construction of digital platform to promote the transformation and upgrading of the construction industry not only helps to promote its high-quality development, but also has a very important practical significance for the development of the whole economy and society.

2 Overview of Digitization in the Construction Industry

BIM technology has been mentioned in a number of studies on the construction industry. According to the research of Merschbrock and Munkvol(2018), a collaborative BIM platform can meet a variety of different needs and make full use of resources[1]. BIM has made considerable progress in practice. For example, digital technologies such as Internet and BIM technology have been comprehensively applied to integrate multiple parts of Qingdao Metro, so as to better coordinate the project progress. At the same time, BIM technology can also help achieve better management.Zhang, F. L. (2019) studied the renovation and expansion project of Vilana International Airport and proved that the digital system based on BIM technology can greatly improve the management efficiency[2].

Based on the existing researches, the path of digital transformation of construction industry can be determined. The first is technology. Ye, J. F. (2022) pointed out that digital innovation should be promoted from three aspects: industrial digitization, controlled digitization and digital industrialization[3]. At the same time, enterprises should build a comprehensive brain and strengthen the integration construction to improve the comprehensive management ability. Timur (2018) believed that BIM digital technology should be integrated with business processes to adjust organizational structure[4]. Wang, G. M. (2022) believes that a digital system should be built to improve the digital level. Second is talent support[5]. On the one hand, enterprises should train and introduce relevant talents. On the other hand, the government also needs to formulate policies to guide. Yan, S. L.(2023) suggested that cooperation between enterprises and universities should be promoted to build a team of talents with high-level and composite abilities[6]. Ye, J. F. (2022) believed that it was necessary to continuously enhance the digital awareness of internal employees and built a talent team with digital capability[7]. Yu, T.(2022) believed that the government and universities should carry out reforms in talent training[8].

3 Problems of Digital Transformation in Construction Industry

At present, the digitization process in the construction industry is relatively slow. By combing and summarizing the existing literature, it is found that there are mainly the following problems in the digital transformation of the construction industry.

The first is lack of cooperative interaction. According to the White Paper on the Development of Digital Architecture (2022), the current digitization of the construction industry is faced with problems such as lack of information communication and cross-professional coordination. As for the application of digital platform in construction industry, Scheweigkofler and her coworkers (2018) describe the developing process of a digital platform that uses augmented reality combined with BIM[9]. Camposano, Haghshenas, and Smolander (2021)present a non-exhausive list of criteria that can evaluate the value of digital platform[10].

The second is the shortage of digital talents and technical support. Tian, Y. P.(2022) believed that the challenges faced by digital transformation of small and medium-sized construction enterprises mainly included insufficient organization and technology[11]. According to Wang, S. M.(2019), the key factor hindering the digital transformation of the construction industry was the lack of professionals with digital training[12].

Third, the overall digitization level of the industry is not high. According to the statistics of China Building Association, domestic construction digitization investment in the total output value of the construction industry accounted for only 0.08%, while the European and American developed countries for 1%, a difference of 12 times. Huang, C. Z.(2022) believed that the integration degree of domestic construction industry and digital economy is low[13]. Tan, W. F.(2022) believed that the current understanding of digitization is not enough, and the existing organizational and business models of enterprises have become important factors to restrict their digitization reform[14].

4 Application of Digitization in Construction Industry – Digital Platform of China Huashi Enterprises Co., Ltd

Facing a new round of technological revolution and industrial change, the construction industry needs continuous innovation to promote its sustainable development. With the application of big data, cloud computing and other new technologies, the platform has gradually become a new carrier of enterprise operation and management. Construction companies have also begun to try to build digital industrial ecology around the platform. Its digital transformation presents a new characteristic: basing on platform and aiming at intelligence. As a comprehensive construction enterprise with the capabilities of investment and development, design and construction, building materials production and financial services, China Huashi Enterprises Co., Ltd has been gradually promoting digital transformation. By building the "Shan Jian Cloud" digital platform, it realizes the online management and sharing, business collaboration and connection of the whole group. Next, the application of digital platform in China Huashi Enterprises Co., Ltd will be analyzed in detail.

4.1 Overall Architecture

The overall architecture of the digital platform in China Huashi Enterprises Co., Ltd is supported by cloud computing, with flexibility and scalability. It can obtain and release resources at any time and quickly, thus greatly reducing resource management costs and improving resource utilization. The cloud computing architecture is divided into three layers: IaaS PaaS ans SaaS.

The IaaS layer is the lowest level infrastructure that provides computing resources, including computing, storage, and networking. Consumers can deploy and run any software on this layer, including operating systems and applications. The PaaS layer serves the application developers. It provides the environment, tools, and services required to support application running, such as database services, log services, and monitoring services, so that application developers can focus on the development of core business. The SaaS layer serves the general users. It provides a complete software system, so that ordinary users only need to use the browser, client and other ways to use the application service deployed on the cloud.

Figure 1 shows the overall architecture design. It is a unified sharing platform based on cloud platform architecture, which can support all types of business of the whole industry. The underlying infrastructure supports the integrated deployment of multiple types of infrastructure, such as public cloud and private cloud. The part above the bottom layer is supported by the data middle office to realize the integration and penetration of cross-domain business data. Through data governance, data modeling and data labeling, it can conduct value mining and analysis on data to form data assets of the group and support operational decisions. The application of upper business mainly focuses on two types of general requirements and business requirements. General requirements include human resource system, OA office system, archives management system and other business systems applicable to the whole industry chain. Business requirements include construction project management system, real estate business system and other business systems in various industrial fields of the group. The key point of digital platform is to realize "project and enterprise integration" and "industry and finance integration". "Project and enterprise integration" is driven by data to realize online and shared management services in the field of construction business, and to realize the fine management of projects and enterprises. "Industry and finance integration" is the integration of business, finance, capital and taxation in the whole industry.

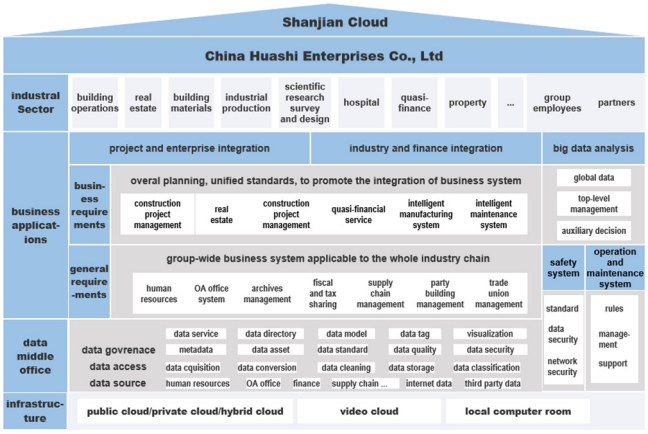

Figure 1. overall architecture diagram

4.2 Business Architecture

The business architecture of the digital platform of China Huashi Enterprises Co., Ltd mainly focuses on the digital design of the organizational structure, business model and operation mode. As shown in **Figure 2**, the platform decomposes service functions and combs business processes according to the functional division of 11 functional centers.

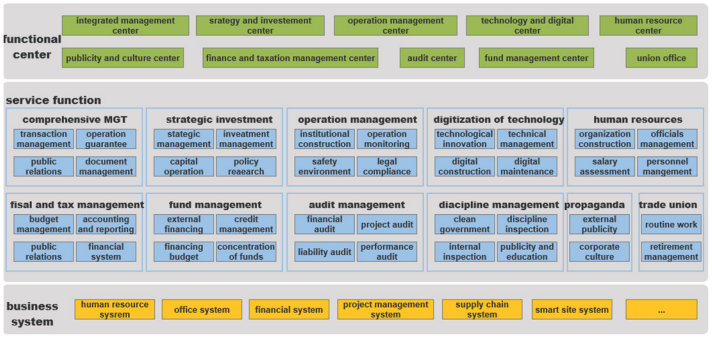

Figure 2. business architecture diagram

4.3 Application Architecture

The digital platform application architecture of China Huashi Enterprises Co., Ltd includes four parts: user system, business layer, data layer and infrastructure. Figure 3 shows the application architecture of the construction business block. It focuses on the construction goal of "project and enterprise integration", and realizes online processing, intelligent data collection and data interconnection in each link of the application industry. "Project and enterprise integration" refers to the whole-process and all-factor business collaboration. It aims to connect project and enterprise data and eliminate data island through data interconnection between horizontal departments, as well as between vertical companies and projects. In this way, the data flow between the project and the enterprise can be two-way. Through the realization of data opening up and data flow, it can help managers at the enterprise level to obtain the real data of the project in time and improve the management efficiency at the enterprise level.

In addition, the platform realizes the integration of business and finance by connecting to the financial sharing system, so as to get through the whole process of construction business operation management, supply chain management, project management and finance and tax management.

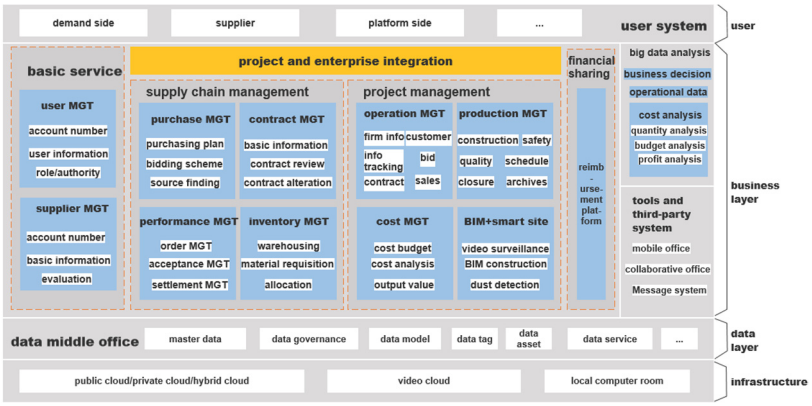

Figure 3. Application architecture diagram of construction business block

4.4 Data Middle Office

The data architecture of the digital platform of China Huashi Enterprises Co., Ltd is based on the “data middle office” , including data source, infrastructure, service capability and other major parts, as shown in **Figure 4**.

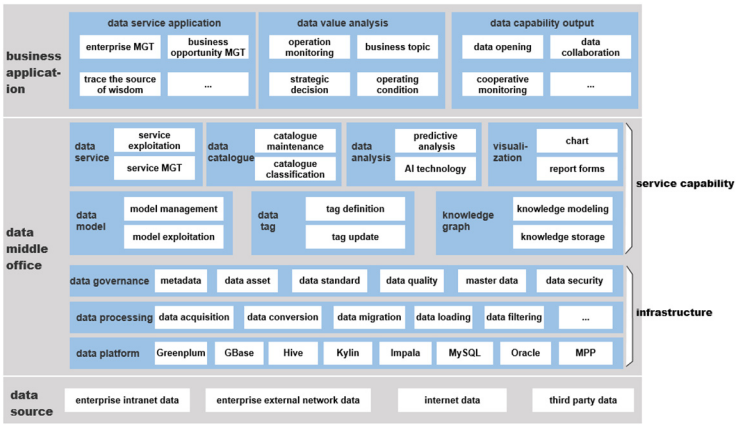

Figure 4. Data architecture diagram of the platform

4.5 Technical Architecture

As shown in **Figure 5**, the technical architecture of the digital platform of China Huashi Enterprises Co., Ltd is divided into infrastructure, data layer, application service, service interface and front-end display.

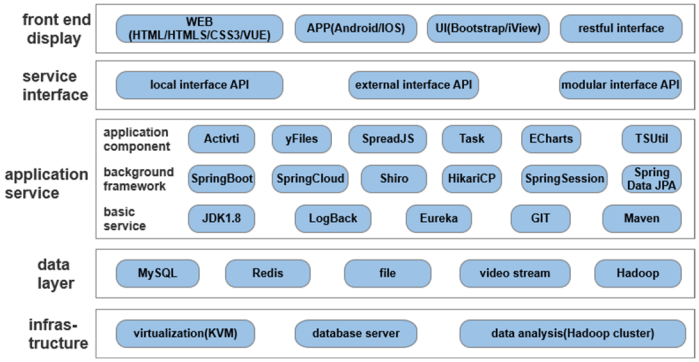

Figure 5. Technical architecture diagram

Infrastructure builds a "hybrid cloud" of private and public clouds. Private clouds use a combination of hardware servers and virtualization. **The data layer** constructs the master data of the digital platform, including personnel information, organization, supplier information, project information, material code, etc. In the data layer, relational database uses MySQL database, memory database uses Redis, file uses unified file storage. **Application service** uses the SpringCloud micro-services framework. **Service interface** can provide local API interface,

external API interface and module API interface. **Front-end display** mainly includes APP support, front-end framework support, Restful interface support, etc.

4.6 The Win Win Case Study-Industrial Digitization

China Huashi Enterprises Co., Ltd has promoted the development of industrial digitization through digital construction, built a community of destiny for engineering construction on the basis of the digitization of the whole chain business, and realized the integration of the industrial chain and digital platform. The "platform + ecology" model can integrate traditional project management and traditional infrastructure into information and digital platforms, and promote data connectivity, resource sharing and business collaboration between upstream and downstream enterprises in the industrial chain. Through industrial digitalization, the construction industry is promoted to achieve efficient resource allocation, digitized cost control, refined project management, and ecological industry enterprises. Data and resources are shared between upstream and downstream enterprises in the construction industry, and new business forms are born under the development of digitization, intelligence, and networking.

5 Planned Achievement

The planned achievement of the digital platform includes the two points: **1) Integration of project and enterprise.** This point focuses on the construction business segment of the Group, through the online construction business, intelligent data collection, data interconnection, the whole process, all elements, and all participants of the business collaboration between enterprises, projects, and between enterprises and projects, including three aspects of collaboration between project departments, between enterprises and projects, and between enterprise departments. **2) Integration of industry and finance.** This point opens up the whole business area of the group, business, finance, capital, tax integration. The three main processes in enterprise operation, as business process, financial accounting process and management process, are organically integrated. This points establishes an integrated financial information processing process based on business event-driven.

6 Conclusion

Under the guidance of the CPC Central Committee and The State Council, the construction industry is facing an urgent need for digital transformation, which will help the construction industry achieve high-quality development. First, it can provide an open, fair and impartial procurement mechanism to prevent and defuse risks. The platform will realize online encryption of all procurement processes, and prevent various risks through the dual cooperation of technology and management.Second, it can break through the construction supply chain to achieve cost reduction and value preservation. Through "cloud computing + blockchain" technology, "end-to-end" data of the whole process of the supply chain can be realized online. Digital and intensive procurement will help reduce costs and ensure that state-owned assets maintain and increase their value.Third, it can build the construction industry ecosystem, connect the upstream and downstream of the construction supply chain, and ensure the stability of the main industry.

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