

Research on the Application of Integrated Construction System in the Field of Prefabricated Buildings

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Abstract

In order to industrialize the construction industry, the integrated manufacturing system should be used for reference. In the process of industrialization of manufacturing industry, the industrial organization mode based on integrated manufacturing system has made remarkable achievements. By referring to the integrated system of manufacturing industry, this paper proposes the construction method of "integrated construction system" in the construction industry, and puts forward the mode framework and implementation path of building information construction.

Keywords

integrated construction system, prefabricated building industry, information technology.

1. Development Status of Prefabricated Informatization

The development of information technology has a great impact on the traditional industry and also provides technical support for the prefabricated building. With the promotion of Internet + to the national strategy, how to realize information management in the construction industry, an important pillar industry in China, has become an important topic. Well known: prefabricated construction as a huge industry system, including: building materials, component parts production, distribution, design, construction, and other subsystems, make full use of the Internet +, promote its combination with prefabricated building more efficient, synergy and development, and provide power and carrier is of great significance for the new type of urbanization[1]. The promotion of Internet + for prefabricated buildings is mainly reflected in four aspects. First, it promotes the collaborative innovation of the whole industry, saying goodbye to the "block-based" development model. Second, promote green and low-carbon development to ensure that the construction process is greener and more economical. Third, through the establishment of modular perception system, promote the information management of the whole life cycle of the building; fourth, improve the quality and efficiency of the construction industry.

As a system project beneficial to the country and the people, on the one hand, it needs the guidance of the government and the innovation of enterprises; on the other hand, it also needs the active participation of various scientific research units, academic institutions and Internet enterprises. More importantly, it is necessary to consider the whole disciplines involved, such as architectural science, project management, construction and Internet technology, so as to achieve seamless connection and coordination and promote the comprehensive industrial reform of the ideology, management mode and development path of the construction industry. All these need to be achieved gradually by studying and establishing the informationized management system of prefabricated buildings.

Prefabricated building refers to the systematic and integrated development of "five-in-one" design, production, construction, decoration and management. It should not be limited to "traditional production mode + assembly" buildings, but should have five characteristics: "standardized design, factory production, assembly construction, integrated decoration and information management. That is to say, using the traditional design, construction and management mode for assembly construction is not assembly building.

The core of the prefabricated building is "integration", and the BIM method is the main line of "integration". This main line connects the whole process of design, production, construction, decoration and management, serving the whole life cycle of design, construction, operation, maintenance and demolition. BIM technology can be used to digitize virtual and informatization describe various system elements, realize new applications such as informatization collaborative design, visual assembly, interaction of engineering quantity information and simulation and inspection of node connection, and integrate the whole industrial chain of architecture to realize all-process and all-directional informatization integration[2]. The combination of prefabricated building and BIM technology has broad prospects.

At the same time, the industrial Internet emphasizes cross-border and post-operation, and USES Internet means to provide owners with real-time and comprehensive services. Cloud computing, BIM, big data, intelligent terminals and ubiquitous network will form a new force and provide an unprecedented tool for the development of prefabricated buildings. In the information age, information technology will be deeply combined with the construction industry, and BIM technology will play a key basic role. The application of BIM technology can greatly improve the integration degree of construction engineering, promote the transformation of production mode in the construction industry, improve the quality and efficiency of investment, design, construction and even the whole life of the project, improve the scientific decision-making and management level, and finally improve the project quality.

2. Problems and Requirements of Informatization Development of Prefabricated Buildings

2.1. Contradictions and Requirements of Design Standardization

Design standardization is the premise of industrialization of architecture. Design standardization and diversification are required to be combined. The design of components and accessories should be serialized and generalized on the basis of standardization.

At present, the industrial process of China's construction industry is artificially separated -- as the most critical initial link of construction products, "architectural design" is listed as an independent industry, which is in a different process from construction. In the concrete engineering practice, the construction side must carry out the design document strictly, according to the chart construction. If there is no obvious error in the design itself, the construction party generally cannot propose corresponding design changes according to its own design intention. The design party of each construction project may be different, and the understanding of the specific building is also varied, and the determined process is not the same, so it is difficult for the construction party to deal with different construction projects with fixed, procedural and industrialized construction technology or parts.

It can be seen that the design and construction of the split, so that the construction side had to face the building is very different, is also the design side in the design without consideration and cannot consider the specific process. The independence of this kind of work makes each time the building construction process is called individual case and cannot realize industrialization.

If BIM technology is used, civil engineering design, structural design and installation design can be carried out, as well as performance analysis of buildings, such as sunshine performance analysis, energy consumption performance analysis, structural performance analysis, and collision detection, etc., so that the problems that may occur on site can be solved before construction. In this way, the graph produced by BIM can achieve error-free design. The BIM model is used to automatically generate the professional construction drawings of horizontal, vertical and profile. In this way, not only repetitive work can be avoided, but also errors can be avoided.

2.2. Contradictions and Requirements of Component Standardization

Generally speaking, the industrial production system of China's construction industry has not been formed yet, and the standardization and universalization level of buildings is very low. The construction mode is still dominated by on-site construction, which leads to the contradiction between the uniqueness of construction projects and the standardization of building industrialization. The uniqueness of engineering appearance is the most basic feature of production management in construction industry, while the standard feature of industrialization is standardization. Standardization is the premise of mass production, while mass production is the guarantee of low cost [3]. Therefore, there must be corresponding contradictions between differentiated construction projects and mass production, which also restrict the development of architectural industrialization. Although buildings are different from each other, the uniqueness of their macrostate does not mean the uniqueness of their microstructure. Due to the specificity of building materials, the similarity of similar building loads, and the similarity of similar building micro-functions, the micro-state of buildings must be similar. Especially in the same area of similar buildings, the performance of this similarity is more obvious.

After years of development, architectural design has formed a complete standardized system, a large number of common buildings, such as office buildings, teaching buildings, such as the span, storey height, load mode, use of materials, structural system and other key parameters have tended to standardized or at least quasi-standardized. Design experience shows that similar buildings in a certain area are almost the same in microstructure and treatment, or at least the related practices of the same design unit and designer are the same. There are many local standard atlas or technical standards in many places in China. If we make conscious treatment on this basis, we can completely realize standardized components and accessories for a specific architectural category, and then realize prefabrication. If BIM technology is used to decompose each part of the constituent engineering into standardized size and shape, the parts can be finalized for production. According to the characteristics of parts in BIM, a parts library can be established, which can include building materials warehouse, prefabricated parts warehouse (prefabricated beams, prefabricated boards, columns, railings, doors, Windows, etc.), furniture warehouse (tables and chairs, kitchen and bathroom, sanitary ware, lamps and lanterns, etc.). When building BIM model, the whole construction project can be built by using part library. Perfect the information of each part when establishing the parts library. Information includes: part number, size information, material information, location information, so as to solve the problem of component standardization. Therefore, using BIM technology to solve the problem of standardization of engineering parts can better solve the irregular and non-standard situation of parts, so as to realize the specialization and commercialization of the production of components, realize the engineering prefabricated construction, and promote the development of prefabricated building to the direction of standardization and refinement[4].

2.3. Contradiction and Demand of Management Informatization

The use of computer and other information means, from the design, production to construction site installation, the whole process of scientific organization and management, which is an important guarantee for the industrialization of architecture.

Information technology is the basic premise and effective guarantee of system integration and organization integration. From the perspective of management mode, the integrated construction system is not a real enterprise, but a loose association formed by many enterprises. Problems such as geographical restrictions, space gaps, standard differences and communication barriers in the process of production and construction organization will lead to slower transmission speed of information instructions than real enterprises, and the deviation will also be greatly increased. Therefore, comprehensive and rapid communication and exchange, reduce the obstacles in information communication, deviation and loss is crucial. Information integration is through the construction of information platform and information portal, so that the integration system and the relevant subcontractors, suppliers and core enterprises in the industrial chain can achieve information sharing, timely communication and office automation; Realize the auxiliary construction process based on information system.

BIM model is a virtual building, through which the project site can be displayed in the computer. In the computer simulation and analysis, if found the problem can be easily solved, this can reduce the number of rework in the construction process, to avoid the waste of resources. In addition, different construction schemes can be compared to select the best one. Because these processes are only computer simulations, they do not waste much time or resources. On the basis of 3D, 4D is used to further simulate the construction. 4D refers to the addition of time dimension on the basis of the 3D model of BIM, so that the construction scheme and process can be tested to ensure the normal and orderly progress of the project. BIM model not only can be 4 d construction simulation in the dimension of the 4 d model on the basis of the increased cost of SD model is established, through the 5 d model can implement intensification of budget and visualization of the project cost, through to the 5 d simulation for the project, get the accurate quantity of all components of the ministry of construction products, realize the cost control.

In addition, informatization not only means the information flow process, but also the informatization of buildings and prefabricated parts. Through information processing technology, building entities as information, and then with the help of the related technology building Construction process virtualization (Virtual Construction, Virtual Construction), the building of "constructability" measurement and evaluation, build the expected buildings and the reality of standardized parts and components, building modules, the relationship between simulating assembling and Construction process simulation, so as to effectively guide the Construction process of reality.

At the same time, in the construction organization, through the information integration and coding control system, the whole process of information management from the disassembly of physical buildings, the organization of standardized components, commissioned processing, to the acceptance of parts, the separation of work packages, the tracking and monitoring of components.

3. The Idea of "Integrated Construction System" in the Construction Industry

3.1. System Integration of Construction Industry.

At present, the independent industrial form of architectural design and construction hinders the smooth development of architectural industrialization. Construction system integration

needs to change the existing mode of design and construction separation, which leads to the absence of the main body of construction technology research and development. Through the integration process of industrial system, the industrial integration system, which takes the construction party as the core, extends forward to the construction process design and backward to the design of prefabricated components, can be realized. Redefine the work content of the design unit, the design unit to the appearance of the building modeling, functional layout, load distribution, grade of energy conservation design. According to the design scheme, the construction party carries out the micro-level construction process design, and then forms the blanking sheet of the prefabricated components. The prefabricated components are outsourced to the specialized prefabricated components manufacturing enterprises for production, and the construction unit is responsible for assembly when they are transported to the site. Get rid of the current scattered mode, re-organize the production process and the main division of labor, so that the design, construction, research and development have integrated system.

The system integration of the construction industry helps to separate the micro components of the building from the macro components, which makes the mass production of prefabricated components possible. At the same time, the person responsible for the quality and safety of the building is clearer than the traditional mode, which can effectively promote the progress of construction technology.

3.2. To Build an Integrated System of Industrial Organizations.

Integrated in the system of industrial organization, there are many provide components for construction enterprises, construction enterprises is no longer building products in the production of vertical industry chain, another construction enterprise of the work content is similar to the decoration construction enterprise now, most of the components in the system can find suppliers, most of the components in the numerical control processing factory manufacturing. The construction project takes the general contractor as the core, responsible for the construction process design, the technical standard design of the components, and the site management. Other participants and the general contractor constitute a subcontract or supply relationship, undertake the professional construction or the production of components. The production organization integration of the construction industry is the key link of the industrialization of the construction industry. Only a mature organization integration production mode can effectively improve the systematic energy saving and emission reduction, reduce the pollution of the construction industry and effectively reduce the construction cost.

3.3. Construction of Information Integration System

Even if the standardization of building micro-components is realized, the procurement quantity and supply schedule for a single building must be connected with the site construction schedule, and the site assembly sequence also needs to be designed in advance and carried out according to the process. Therefore, the integration of architectural information is particularly important. Now, BIM (5D) technology, which USES information technology to informatize physical buildings and realize full informatized management of construction process, has become mature. In the information integrated construction system, the construction party, the owner party, the component parts supplier, the subcontractor and the supervision department can share the dynamic construction model information in real time to ensure the effective transmission of information within the system.

The construction of integrated construction system is the key path to promote the industrialization of architecture in China, and it is also the most difficult link to complete. It is related to the reconstruction of the whole existing construction management and supervision system, and the change of the main business of enterprises in the traditional construction industry chain.

4. Design of Information Construction Mode of Prefabricated Buildings

4.1. Pattern Framework

Intelligent manufacturing of building components Building intelligent manufacturing, is to introduce the concept of modern digital factory, according to user needs, quickly collecting resource information, process information and resource information analysis, planning, and restructuring, the implementation of product design and the function of simulation and prototype manufacturing, and then quickly produce product performance meet the user requirements of the entire manufacturing process. Digital factory system with the combination of prefabricated concrete component parts factory is going to be a big trend, the future of prefabricated building digital embedded will make component parts production process more reasonable, the production arrangement is more rigorous, improving precision of component parts and the degree of quality, so as to create a modern intelligent building component parts are big factory.

Modeling of building information. (BIM) Building Information Modelling is based on the relevant Information data of construction projects to establish the Building model and simulate the real Information of buildings through digital Information simulation [5]. It has five characteristics of visualization, coordination, simulation, optimization and graphic ability.

Intelligent building system. (1) Intelligent buildings. Building as a platform, both information facilities system, information application system, construction equipment management system, public safety system, set structure, system, service, management and optimization as one, to provide people with a safe, efficient, convenient, energy saving, environmental protection, healthy building environment.

(2) Smart city. Smart buildings gradually develop from single to regional, thus developing into a large range of buildings and building areas of the comprehensive intelligent community. Through the connection of smart buildings, wide-area communication network between smart communities and communication management center, the whole city will develop into a smart city.

Intelligent operation system. It is the Internet thinking, driven by the platform construction, to efficiently integrate the construction industry chain and construct the ecological map of prefabricated buildings (figure 1).

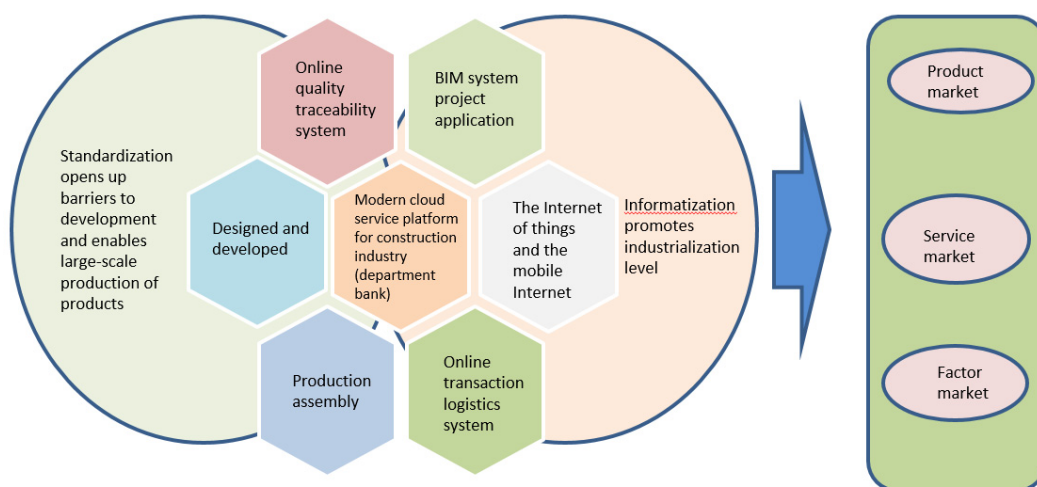


Fig 1: schematic diagram of assembled building big data intelligent operation platform

The key point is to construct three centers to drive the whole industrial chain of the construction industry. Realize the online and offline interaction between production and consumers (figure 2).

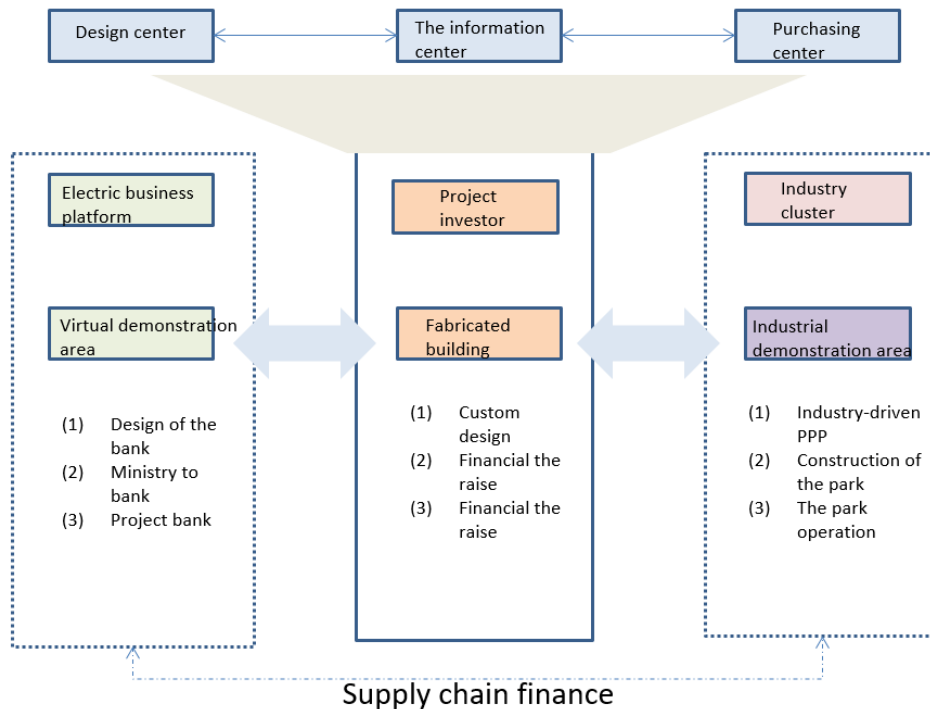


Fig 2: big data operation structure diagram of prefabricated building

4.2. Pattern Implementation Path

Based on the concept of online and offline "physical information integration", the company actively USES the Internet and BIM technology to promote the efficient integration of the industry from the perspective of sustainable development of the whole industry. Give full play to the power of all sectors of society, form a social cooperation circle of "politics - industry - learning - research - investment - media - media", build a "platform", "perception", "application", "transmission" and "support" system, and create an Internet + prefabricated building ecosystem.

"Platform layer" -- cloud platform system It mainly refers to the platform services for the design, production and transaction of the construction industry, which can be not only the service agglomeration and interactive system at the physical level, but also the network platform based on the interconnection thinking. It mainly includes: design cloud community, construction new material e-commerce platform, component bank and technology research and development and standard promotion centre, etc.

- (1) O2O cloud design community (such as Vanke cloud and smart building design APP);
- (2) Building new material e-commerce platform (transaction function);
- (3) Product bank;
- (4) Technology research and development and standard promotion centre.

"Perception layer" -- data detection and acquisition system It mainly refers to the thinking of big data, which actively complies with the needs of the DT era to conduct timely dynamic monitoring of individual enterprises, monomer buildings and construction parts in the construction industry, and timely make necessary emergency strategy data and perception system. It mainly includes industry dynamic monitoring of the construction industry, BIM based part warehouse cloud platform, building life cycle detection, intelligent pipe gallery, etc.

- (1) Dynamic monitoring of industry data;
- (2) Part warehouse based on BIM (e.g., guanglian cloud);
- (3) Building life-cycle detection system (building + sensor, which is equipped with "core");
- (4) Wisdom pipe gallery.

"Application layer" -- innovation demonstration system It mainly refers to the specific application of smart technologies and solutions in production and construction, including the micro-level intelligent construction of enterprises, smart construction sites and smart production line systems, as well as the meso-level smart park construction, urban demonstration, regional assembly building demonstration, as well as the scene application in daily life.

- (1) Smart enterprises (such as the application of guanglianda project cost, engineering design and software by various construction enterprises);
- (2) Smart site;
- (3) Intelligent production system (efficient production line, production software development);
- (4) Demonstration of park construction (production of new material park and construction parts);
- (5) Urban demonstration (" Internet + prefabricated building demonstration "at the provincial or county level);
- (6) Smart application scenario development (smart home, smart elderly care community, green energy saving monitoring).

"Transport layer" -- information and logistics system It mainly serves the transmission system of talent flow, information flow and logistics in the construction industry, including both the physical distribution system and the network service provider based on information transmission.

- (1) Logistics distribution system;
- (2) Internet service providers.

"Support layer" -- organizational and operational support system It mainly refers to the decision-making guarantee, organizational guarantee, operation guarantee and logistics guarantee system as well as the industrial ecological environment guarantee system to promote the high integration of prefabricated buildings and the Internet. Such as: city alliance, industry association, credit agencies, conference and exhibition, trade training, supply chain finance and innovative finance of small and medium-sized enterprises.

- (1) City alliance;
- (2) Trade associations;
- (3) Credit reporting agencies;
- (4) Conference, exhibition, education and training;
- (5) supply chain finance;
- (6) Innovative finance for small and medium-sized enterprises.

"External resource layer" -- construction machinery and equipment (1) Production equipment for prefabricated concrete parts;

- (2) Construction machinery;
- (3) Other installation equipment.

5. Conclusion

The key to popularize and apply the prefabricated building information management system is to build the whole industrial chain of the building industry and integrate the professional fields

of building science, project management, construction and Internet technology. By building the Internet + prefabricated building ecosystem, the comprehensive industrial reform of the construction industry's ideology, management mode and development path can be promoted, so as to establish the information management system of prefabricated buildings.

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