

The specific methods of the upgrade of the prefabricated construction industry

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ABSTRACT. *With the industrialization and modernization of construction industry, prefabricated construction industry becomes more and more important. In this paper, we explore some major methods, including technological services, business services and policy support, to promote the upgrade of the prefabricated construction industry. Based on the analysis of specific promotion methods, the paper presents detailed upgrading prefabricated building features of each stage, leading to the guidance for the upgrade of the prefabricated building industry.*

KEYWORDS: *prefabricated construction industry, upgrade, technological services, business services , policy support*

1. Introduction

Nowadays, China has been developing the prefabricated construction industry. In order to promote the development of prefabricated construction industry, Chinese government has formulated industrial development plans. However, the stage of current development is still relatively low. It is urgent to promote the upgrade of prefabricated construction industry through certain measures and means.

In the study of industrial upgrading, scholars have conducted many researches on the characteristics of different types of industries and different regions. Santiago Martinez and Alberto Jardon studied the technologies such as automatic lifting of prefabricated modules by robots on the construction site and mobile factory, which can not only improve the production efficiency of prefabricated components, but also reduce the labor cost[1]. Fastabend et al. adopted a semi-prefabricated ceiling in prefabricated house construction, optimized the installation method of the ceiling through a series of algorithms, and improved the integrated installation level of the house[2]. Kalasapudi et al. proposed a method combining adaptive 3d imaging and spatial pattern analysis to analyze the assembly process of prefabricated components in detail, ensuring the unity of the design stage and the assembly stage without deviation and eliminate construction risks[3]. In terms of business services, Deng xiangrong et al. studied the role of finance in upgrading industrial structure. He found that financial agglomeration in the eastern region played an obvious role in promoting industrial structure upgrading.[4] Soete took the United States, Britain

and Germany as examples to study their innovation policies. She found that fiscal support policies, tax support policies, government procurement policies and other fiscal and tax measures can effectively promote the adjustment and optimization of industrial structure[5].

This paper is divided in three parts: Firstly, we presents prefabricated construction industry development present situation in China and reviews some relevant research as mentioned above. Then, three types of the upgrade of prefabricated construction measures are put forward including technology innovation, business services and government policy support. Finally we describes the upgrading situation of each link after the functions of these three measures, so as to provide suggestions for promoting the upgrade of the prefabricated construction industry .

2.Service system and policy support for updating

2.1Technological services

For any industry, technology innovation is the most important driver of industrial upgrading. We should pay attention to the innovation of prefabricated construction technology, informatization and innovation of the organizational management for the complex prefabricated construction industry chain.

In terms of technology innovation, it is firstly necessary to improve the design, production, construction and installation methods. In the design stage, we should upgrade the design capability of the prefabricated building, which can break through the applicable limitations of the current fabricated building and apply it to more common situation, while we have developed relatively maturely in the field of fabricated steel structures. For the design and application of fabricated concrete structures, we can still make progress in combination with the production and construction characteristics of fabricated buildings. In the production stage, the automation and efficiency of the production process should be improved through technology innovation. In the meanwhile, the quality and performance of parts and construction equipment should be improved too. In the construction and installation stage, technology innovation can promote the installation precision of prefabricated building during the construction phase. The higher the level of automation on site is, the stronger the structural performance of the building products will be.

In terms of informatization, the first step is to make better use of the integration function of the BIM platform, which enables you to track and record the whole process from design to operation. As a result, the effective connection and management of the assembly building construction process will be improved. Moreover, set up the building's big data platform during the whole process. We can collect the design data of parts and components, the status of installation equipment, the operation data of finished construction products and so on to analyze, so that we can make efficient use of materials in the prefabricated construction market.

In terms of organizational management, firstly we should conduct effective research on the market demand of the enterprise. And then adjust the operation and management mode of the demand for the assembled building in the market, besides, expand the market share of the fabricated building. The second is to implement a lean and agile management model. The assembly-type construction industry has been able to achieve mass production to a certain extent, but the customization is relatively weak compared to traditional buildings. Coordinating the relationship between batch and customization can help us take advantage of the prefabricated construction industry. Thirdly, the whole process of consulting management mode should be promoted. With the in-depth development of the fabricated building industry, the whole life cycle management application can promote the sustainable development of prefabricated buildings.

2.2 Business services

Enhancing business services can be done in three ways.

We should actively build investment and financing platform for the assembly-type construction industry. Firstly, we can improve the venture capital system of the prefabricated construction industry, introduce a team of venture capital experts with international operation level and management ability, formulate and issue preferential policies on investment and financing, in order to increase the supply of venture capital of the prefabricated construction industry. Secondly, we should strive for special support funds from the state and regions, increase cooperation with financial institutions such as banks, actively use social capital and PPP models, and strive to plan assembly-type products that meet national industrial policies and regional development requirements. Thirdly, we can establish a financing guarantee mechanism for the assembly-type construction industry chain, innovate financing models. In order to establish a special investment fund for the assembly-type construction industry with the market as the fundamental role, we should strengthen exchanges and cooperation with financial institutions, insurance, securities, investment companies and other institutions, comprehensively integrate financial funds.

We can try to cultivate the financial system of assembly construction industry chain. Industrial chain finance closely links financial institutions with industrial chains, and can provide comprehensive financial solutions for the entire industry chain based on transactions in the industrial chain, including supply chain financing services, personalized supporting financial solutions, investment and financing. Now, the development of industrial chain finance is inseparable from the support of cutting-edge financial technology, such as big data technology, cloud computing, blockchain technology and artificial intelligence. Big data technology connects data in all links of the industry chain, and integrates and utilizes various dimensions of data to help financial institutions reduce marketing costs, improve capital use efficiency, and rationally avoid risks. Cloud computing technology can highly integrate the information flow, logistics and capital flow of industrial chain finance, thereby financial institutions and enterprises can reduce the overall cost in the

industrial chain. The decentralized and anti-tampering nature of blockchain technology[6] is conducive to the construction of a decentralized mutual trust mechanism, and we can connect industrial chain enterprises and financial institutions, form a chain of trust transmission mechanism, reduce the cost of trust and finance costs of the entire industrial chain by using this technology. Artificial intelligence can deeply interpret transaction data in the industry chain, thus greatly improve the efficiency of data utilization, and more accurately estimate the true value of the enterprise, especially high-tech light assets, through the deconstruction and analysis of business data. In summary, the use of cutting-edge technology such as big data, cloud computing, blockchain and artificial intelligence can optimize the customer channel, improve operational efficiency, reduce operating costs, strengthen risk control, and help create a transparent, efficient, risk-controlled industrial chain and financial ecosystem[7].

We can build a trade platform for the assembly-type construction industry, actively build the economic effects of the headquarters of the assembly-type construction industry. We should establish the regional headquarters of domestic enterprises or multinational companies in the field of prefabricated construction related to decoration materials, parts and components, production, supporting services and so on. At the same time, we can build an offline trade exhibition center integrating the transaction, leasing, logistics, supporting services and exhibition of fabricated construction products. Also providing leasing market cultivating the leasing services of assembly construction production, transportation, construction and installation equipment are important. Under the current development of network technology and information technology, although the construction industry products are not as suitable for e-commerce platforms as manufacturing products, it can also be used for some products such as household products and decoration products. The development of the assembly-type construction industry is also inseparable from the corresponding supporting services, such as accounting, taxation, auditing, law, credit investigation and rating, advertising, etc , which can be set up in an offline business center.

2.3 Policy support

Under the background of developing the industrialization of construction, the prefabricated construction industry is an important part of realizing the industrialization of construction. The implementation of government policies is an important driving force for the sustainable development of industrial chain, whether it is directly supporting enterprises or supporting scientific and technological management services and business services.

The local government can study and formulate special support and promotion policies for prefabricated buildings, such as market promotion, land support, fiscal and taxation, financial support, infrastructure support, talent introduction, administrative approval, logistics and transportation, etc. These policies can provide support for the upgrade of the industrial chain of prefabricated construction.

The local government can optimize the industrial planning of the region. They can promote the establishment of an industrial alliance of the whole or any link of the assembly construction industry so as to expand the competitiveness of the regional assembly industry chain. Besides, rationally planning the regional location of the prefabricated building and establishing the production of the fabricated construction industry are important, which can improve the cooperation between various enterprises. Then the local government can promote the construction of infrastructure related to the assembly-type construction industry, such as transportation corridors and storage locations of industrial parks or fabricated building parts.

3.The specific performance after each link of the industrial chain upgraded

3.1 Design stage

The upgrade of the prefabricated construction industry chain brings the design technology enhancement and innovation to this stage. The improvement of design technology can enhance its adaptability to the production and construction stage of prefabricated buildings and ensure their excellent structural performance. And the improvement of design technology can expand the applicability of the current prefabricated building, so that it will be used in high-rise housing or complex structure of social public projects, so as to meet the needs of people's life and social development. It can be applied in social public projects to meet the multi-faceted needs of the people's life and social development. After contenting the needs of prefabricated architectural design in the region, it can also realize the development of the external market, export design technology and services, and build the brand of prefabricated architectural design.

3.2 Production stage

The effects of the upgrade of the prefabricated construction industry on the production process are mainly manifested in the following aspects: 1) transforming design drawings into production drawings of parts and components with the help of information technology, and realizing the intelligent application and efficient utilization of molds. 2) developing energy-saving and environment-friendly building materials with higher performance by utilizing advanced environmental protection technology and material research and development technology, so as to further reflect the advantages of prefabricated buildings. Walker, P and Thomson, A proposed that natural materials, such as straw, clay and hemp ash, could be applied to the production of prefabricated components through technology innovation with the help of prefabricated construction factory prefabrication and on-site assembly, so as to build more environmentally friendly and healthy houses[8].3) home automation products are also an important part of the upgrade of the production link. At present, home automation is entering thousands of households and is warmly welcomed by consumers. The production of home automation can meet the

personalized needs of consumers, and diversified products can effectively expand the market and increase the profit of the industry. 4) technical transformation improves the function of installation equipment, improves installation accuracy and enhances installation efficiency. Haitao Yu et al. applied the commonly used lean tools (5S, time management, value stream, etc.) to the production of prefabricated components and developed an advanced production system suitable for building modules, which reduced the cost of prefabrication and improved the efficiency of prefabrication.[9]

3.3 Transport stage

The transportation stage mainly transporting the products from the production site to the construction site, including parts and components, installation equipment, decoration products, household products, etc. The transportation of some decoration or household products can be basically satisfied by ordinary logistics, but large parts of components and installation equipment need targeted logistics channels and logistics methods. What effect will the industrial upgrading have on the transportation stage? 1) making use of the local geographical environment and infrastructure conditions to build a matching logistics channel, which can provide basic guarantee for the transportation of components and installation equipment. 2) building an intelligent logistics system with computer technology, which can realize efficient connection between transportation, storage and installation, and avoid large amount of hoarding in the production plant and site. Therefore, it can not only ensure the normal construction period, but also reduce the storage pressure. (4) Installation and construction stage

In the construction stage of the assembly construction industry chain, the industrial upgrading mainly realizes intelligent safety management and intelligent progress management. Compared with traditional buildings, the prefabricated buildings have prominent advantages in construction safety and stability of schedule. 1) after industrial upgrading, information technology can be used to establish an intelligent management platform related to safety and progress, improve management efficiency and enhance management effect. Thus, the informatization degree of the whole construction process of the prefabricated building can be improved and a complete information system can be established step by step. Zhang chang et al. combined RFID technology with prefabricated buildings, and implanted special RFID tags containing various information into prefabricated components after the factory was finished. In this way, the transportation, entry, installation and operation status of components can be obtained in real time, which is conducive to reducing material consumption, reducing labor cost, timely tracking and adjusting progress, and improving the safety of components[9]. 2) Another goal of the upgrade in this stage is to establish a professional industrial worker team through theoretical and practical training, so as to establish a professional human resource company to achieve sustainable talent management and promotion.

3.4 Decoration stage

The upgrade of the prefabricated construction industry chain will bring about the transformation and upgrading of the decoration stage, which can be mainly reflected in the hardcover delivery, VR decoration effect, and home intelligence. Hardcover delivery has been more commonly used in real estate projects, but the current consumer satisfaction with fine decoration is not high, and it needs to be strengthened in the construction of social public facilities and places, so we must focus on improving the decoration. The popularity and quality of the decoration. The decoration effect or the choice of style can be demonstrated in advance by using VR technology, in order to provide consumers with more choices, and to clarify the specific requirements of the decoration, so as to enhance the cooperation relationship between the two parties. In the decoration process, the home is also an important part, and can actively use the Internet of Things, artificial intelligence and other technologies to establish a joint network for different functions of home, to provide consumers with a more convenient and beautiful living environment.

3.6 Operation stage

The transformation and upgrading in this stage is mainly reflected in the sustainable maintenance of construction products, the guidance and development of new market demand and the contribution to regional economic development. Intelligent system can be used to manage construction products, including timely collection of building operation data, intelligent processing and response, and feedback of some problems and experience for the production process of other buildings. The guidance and development of new market demand are mainly reflected in the expansion of market demand for personalized refined products, especially real estate projects. The contribution of construction projects to regional economic development is reflected in the demand for new construction or reconstruction of construction products by the development of social emerging industries, such as the construction of start-up towns, tourist project cluster demonstration areas, etc. The advantages of prefabricated buildings can be well reflected in these projects.

To sum up, for the whole life cycle of the assembly building, on the basis of upgrading in each stage, the whole process information pooling platform can be established. For example, Poirier, EA et al. studied that the adoption of BIM in prefabricated construction commercial projects would increase labor productivity from 75% to 240% [10]. The advanced technology and management experience in addition to being able to meet the development of prefabricated construction industry chain in this region, can also through the establishment of the form of technology services company, will be advanced technology and management experience in a technical management system, products are exported to other regions to provide technical product support, increase the value-added chain technology and management.

4. Conclusion

In this paper, specific measures to promote the upgrade of the prefabricated construction industry can be sorted out by means of technology innovation, business services and policy support, and some beneficial measures and Suggestions are put forward based on the analysis of each link of the industry, which can be summarized as figure 1. However, in the process of demonstration in this paper, there are still some links that lack data demonstration, which involves a wide range of aspects and makes the depth not enough, so it needs to be strengthened in the following research.

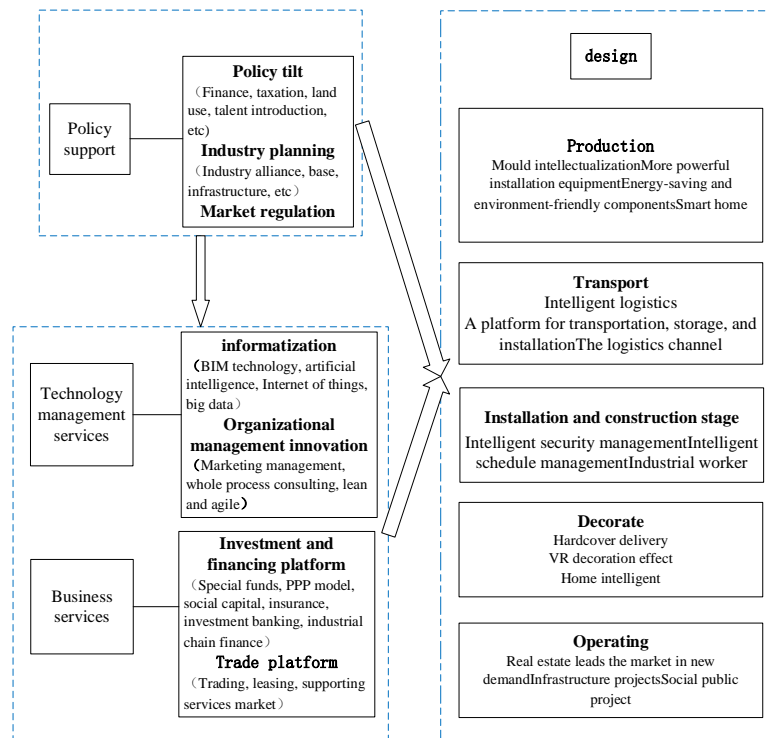


Figure 1: The concrete manifestation of the upgrade of prefabricated construction industry

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