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## Preliminary Study on Lean Management Mode of Prefabricated Factories

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**Abstract** As the main production way of the prefabricated buildings, the prefabricated factories are the core of the quality of the prefabricated buildings, the foundation of the cost, the method of technological progress, and the motive force of the sustainable development of the industry. There are many problems in the operation of prefabricated factories, such as high cost, low quality and lack of talents and so on. So we need to improve it. The lean production management concept is introduced in this paper, and the lean production plan of prefabricated factories has been established to solve the problem of prefabricated factories' operation, which can be used for reference for the benign development of prefabricated component production process.

**Keywords** prefabricated buildings; prefabricated factories' operation; lean management

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### Introduction

Policies are published successively by central and local government organs on encouraging a strong development of prefabricated construction, responding to the call of the modernization of construction industry. Therefore, there has never been such a time that prefabricated construction is accelerated and expanding its market. But as currently envisaged, prefabricated construction application in our country exists some difficulties. Achieving the goal of industry transformation which takes product production factory and site construction assembly into the main line of modern architecture affected by prefabricated building construction costs. It is difficult to expand the market because of the high costs, and the high costs also increase market acceptance.

According to relevant data, prefabricated buildings per square meter cost high 500-800 yuan more than traditional cast-in-situ. Though analysis of prefabricated construction costs, we can know that the costs of PC components and installation accounted for the largest of prefabricated building costs, which can be as high as 67.41%. Further investigation and analysis shows that the prefabricated installation costs about 20%, and the production costs of prefabricated components account for the most.

In order to further promote the sustainable and healthy development of the prefabricated buildings, the costs of prefabricated buildings should be solved first. And the main reason for the high costs of prefabricated buildings is the production costs of prefabricated components. At the same time, the period and quality of prefabricated components' production directly affect the progress and quality of prefabricated buildings. In order to solve the problem of production costs of prefabricated components, we need to start from prefabricated factory.

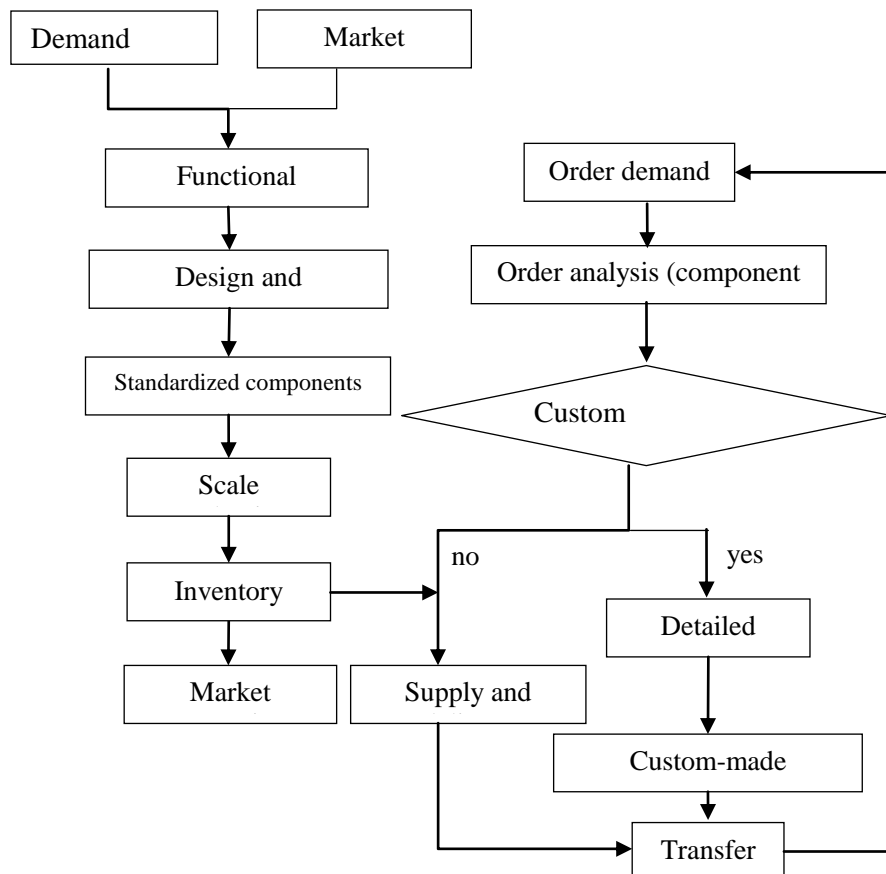
### Prefabricated factories' operation

Mass customization production is the development trend of the precast factories' effective production, and is also the advanced production mode of production. Based on meeting the personalized requirements of fabricated buildings, it can effectively reduce the production costs to obtain economic benefits. Mass customization production combines the advantages of customization production and mass production, such as meeting the diversity and flexibility of customers' demands though customization and quality consistency and low costs through mass production. At the same time, we have overcome the shortcomings of the demands for customized



production, poor quality consistency and the lack of flexibility in mass production, so as to provide cost-effective products for customers' needs.

Prefabricated factories' implementation of mass customization production have solved the contradiction between order differentiation production and mass production. It can effectively reduce the costs of precast factories' production, achieving their economic benefits. Mass customization is a collection of development design, production, distribution, etc. With the advantages of customization production and mass production, it responds to customers' demands and quickly analysis customers' personalization. Under this mode, prefabricated factories can respond to diversification demands according to the production capacity, and can improve the production efficiency through the use of standardized, modular design and the processing time. Compared with The business process of large-scale customized production in the automobile manufacturing industry, and combined with the actual characteristics of prefabricated factories, the author established its main business process as follows:



Picture 1: The main business flow chart of prefabricated factories' mass customization

### The problems' description of prefabricated factories' operation

(1) The production arrangement is unreasonable and the material supply is difficult to guarantee.

Prefabricated components' production is based on orders' demand. Due to the industrialized production, the production should be based on the progress of the prefabricated buildings and supplies inventory was carried out on the production plan ahead of schedule, according to the plan to put into production at the same time, and it's the precondition of prefabricated factories' production. The composition of prefabricated components is relatively simple, including steel reinforcement, cement and other new materials, such as casing, etc. Although there are relatively few kinds of component materials, the actual market supplies of materials are difficult to grasp. Purchasing of materials generally is worked according to the phase current factories' schedule of organization plan and budgets for purchasing plan arrangement, but a large part of the factories can't complete



purchase plan according to actual demands, leading to the lack of raw material inventories, and causing the shortages' costs. Finally, it can't guarantee the run of normal production.

(2) Detailed design capacity is insufficient and production quality can't be guaranteed

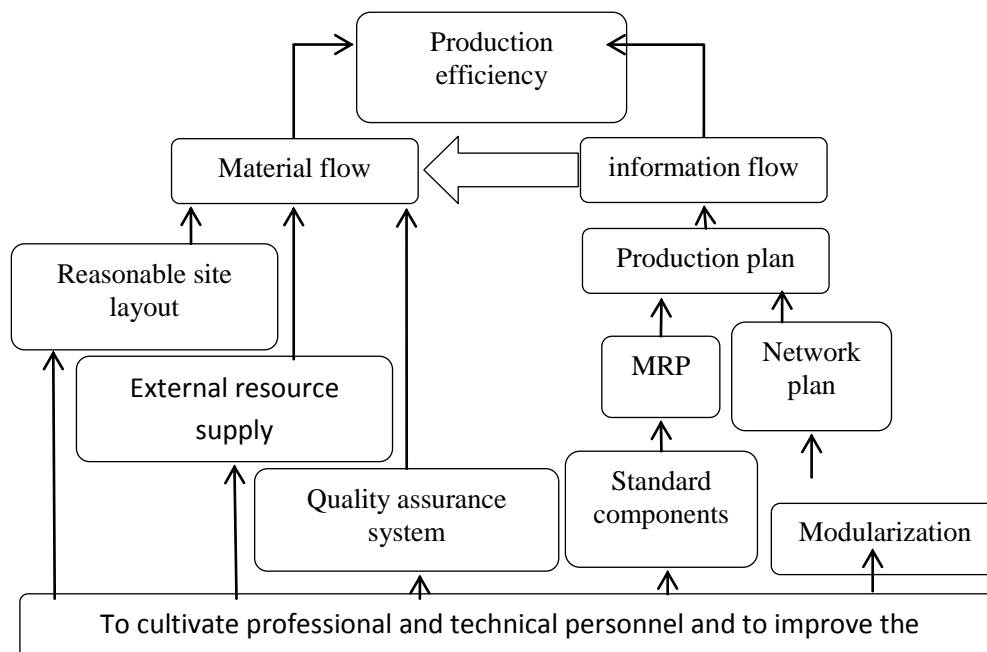
Production of prefabricated components take module drawings as standard, and the drawings that prefabricated factories get to refer are often the traditional construction drawings. Detailed design is for the deeper decomposition and refinement of the design which is not very complete and is specific to each piece of wall plate, composite plate, such as prefabricated production drawings, to guide the precast production. So it is the basis of the production. The production of prefabricated buildings have no unified standard system and production specifications to follow, so that it makes that the production quality control and acceptance are controlled by the precast factories based on lowest production quality. At the same time, standard system imperfect makes the design of the prefabricated production progress slow and the efficiency low, leading to lack of standardization of the design and leading production generalization degree not high. So it's difficult to form large-scale production.

(3) Lack of professional technical personnel and insufficient application of information technology.

Due to characteristics of construction products manufacturing, higher requirements on production technology makes a great demand for skilled workers. The inputs of professional technical personnel directly affect the efficiency of production. At the same time, there is a lack of early design professional technical personnel. Meanwhile the cultivation of the prefabricated factories of relevant technical personnel and lack of education makes lack of the high quality and skilled construction workers. The prefabricated factories have a low application degree of information technology, and haven't established the information feedback mechanism to timely adjust the operation related information and optimize the production operation.

### 3. Lean management scheme

Lean management scheme's overall frame work is designed to realize "low cost, high quality" as the goal, to improve the efficiency of prefabricated factories as a guide, combining with the prefabricated factories' production process and production operation based on the problems existing in the process of design. In order to meet the market demands, lean management concept is introduced.



Picture 2: Lean management scheme's overall framework

It is based on the implementation of pull production to establish flat production command system and stable operation of the efficient internal production plan arrangement. And through the stable process control, the



consumption of precise control and the site management to improve continuous effectiveness and ensure the efficiency of production, so as to increase production efficiency. Through lean production management, the author set up the integration of the resource allocation and information feedback timely management information database, including the information of inventory management, technical personnel and the process monitoring, in order to realize the effective operation of precast plant. Lean management scheme's overall framework is shown in picture 2.

(1) Setting up a standard prefabricated components' library

In order to realize the low cost of rapid production and mass production, the prefabricated components should be decomposed, and the internal relations and the essential features between the prefabricated components should be analyzed, so the standard components with certain norms and generality should be set up to realize the batch production of various standard components. With the viewpoint of delayed manufacturing, the delayed manufacturing point can be customized to produce downstream mobile as much as possible, so that the customization production that meets individual needs is reduced. After receiving differentiated orders from customers, detailed adjustment and further design are carried out on demand based on the standard prefabricated component library to achieve rapid customization.

(2) Building material requirement planning (MRP)

According to the unreasonable production schedule, we use information technology to analyze the logistics demands of production operation system, and establish material requirement plan. The material demand plan (MRP) means that it is based on the delivery date of the final product stipulated in the schedule of the total production. The production schedule of the parts and parts of the final product, the foreign purchase plan, and the production plan within the final product are the information system for the effective realization of the production plan. According to the production characteristics of prefabricated factories, first of all, the structure number of prefabricated components should be analyzed, the material is divided by prefabricated components, the same raw material is classified and classified in order to unified planning and management, and then the BOM calculation of the refined material is used as the core of the material resource demand plan. According to the nodes decomposed by the product structure tree, we calculate the demand for each raw material and accessories in the planning period as the basis for the production plan.

(3) Analysis of network planning under module

Modularization is from the point of view of the system, to study the form of the production or system. To decompose it and to simplify the organization are benefit to make the overall plan. In the process of production and operation of prefabricated factories, the production process is decomposed with the change of production process as the basis of modularization, which can be divided into the modules of material planning, reinforcement technology, concrete technology, maintenance and so on. The network planning method is a project planning method. Under the premise of modularization, we can achieve the whole project by controlling the production process, so as to control the key nodes and control the overall situation. Using the network plan, the production of the prefabricated components can be grasped in real time, the product is corresponding to the plan network, the module corresponds to the network plan "process" or the node, and the node parameters correspond to the connection relationship between the completion time module and the arrow line of the planned network. Through the analysis of the earliest start time, the latest time and the time difference, the travel production plan is determined, and the optimized adjustment is made according to the actual situation, in order to realize the planned arrangement of the prefabricated components' production.

(4) Optimizing the rational layout of the field

From the point of material flow, the material flow is the main object of production management. The reasonable production line setting can reduce the unnecessary ferry operation and reduce the cost. At the same time, the rationalization of the equipment layout can reduce the cost of logistics equipment, reduce the number of handling staff and the number of workers, and reduce the intensity of logistics, so it can improve the safety of the production site.

(5) Integration of external resources supply

The supply of external resources refers to the integration of the resource conditions related to the production and operation of prefabricated components, including the supply of raw materials, and can effectively realize the



establishment of the industrial alliance. At the same time, it can manage the relevant parties of the supply chain by means of information technology, realize the integration of the supply chain, effectively deal with the effects of the purchase of raw materials that the market changes may bring, and ensure the orderly conduct of production.

(6) Establishing the quality assurance system

One of the standards for prefabricated components inspection is quality. The quality assurance system should include the production quality standard, the quality acceptance standard, the quality inspection and so on, and the quality error control range of each process in the production process is clearly defined. Establishing quality assurance system is the basic condition for achieving total quality management. The prefabricated factories define and improve the quality standards of prefabricated components according to relevant standards and production technology to achieve high quality of prefabricated components.

(7) Pay attention to the training of talents and adjust the structure of the organization

Talents include technical talents, factory management talents and technological innovation talents involved in the process of production. The training of talents refers to the establishment of a set of effective management methods for personnel protection, including joint related training institutions, in accordance with the actual production needs and employees' own development needs according to the objectives and strategic development of the factory. To establish a vocational skill training system and to accelerate the training of technical talents by organizing related skills training courses, skills identification and skill competitions. At the same time, the training of talents includes innovative talents training, and innovative talents are the main force to realize technological innovation of enterprises, which is also the basis for the implementation of lean production management plan. The flat organization structure is more clear to the division of labor than others. It separates the production and supply and avoids the incomplete and untimely information transmission. Establishing the flat organization of the prefabricated factories can guarantee the continuous efficiency of the stable operation.

(8) Using the means of information

The BIM technology is applied to the collaborative lean management process of prefabricated components' design, production and assemble to realize the one-time molding design of prefabricated components, reduce the incremental cost brought by the change, and realize the cooperative work of the relevant parties. At the same time, the ERP system development of prefabricated factories, component information management system (PCIS) based on component RFID technology are applied. Rely on the lean production of the Kanban management of the related process technology process of component production, and the material flow to track and manage, we can realize the lean production process of high production efficiency and low wave cost.

## Conclusion

As the main production way of the prefabricated buildings, the prefabricated factories are the core of the quality of the prefabricated buildings, the foundation of the cost, the method of technological progress, and the motive force of the sustainable development of the industry. In this paper, lean management concept design of manufacturing industry is introduced to meet the demand of production operation. From the point of view of material flow and information flow, the lean production management scheme is set up from the angle of material flow and information flow, and suggestions are put forward to improve the operation of prefabricated factory.

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