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Research on the Mechanism and Path of Custom Furniture Industry Transformation Driven by Modular Design

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Abstract: ***With the continuous upgrading of household consumption demand, the traditional whole house customization mode not only meets the individual needs, but also exposes the problems of high non-standard production, long delivery cycle, high service cost and opaque price. In the face of the contradiction between enterprises' cost reduction and efficiency increase and consumers' demand for high cost performance, the furniture industry urgently needs to explore a new model that takes into account both standardized efficiency and personalized experience. Based on the flexible combination of standardized components, modular design transforms furniture products from' overall non-standard 'to' standard module combination + local precise customization', thereby reducing comprehensive service costs, improving delivery efficiency, and retaining the necessary space adaptation capabilities. Based on the theory of mass customization and modular design, this paper analyzes the development dilemma of traditional full-custom furniture mode, and discusses the operation logic, application value and implementation path of modular standardized customization mode. According to the research, modular design is not to weaken customization, but to achieve a win-win situation among enterprises, consumers and the industry through a differentiated combination on the basis of standardization, and to provide a new development direction for the transformation and upgrading of the customized furniture industry.***

Keywords: Customized furniture design, Whole house custom furniture, Modular design, Standardization module, Precise customization.

1. Introduction

1.1 Research Background

In recent years, with the improvement of people's living standards and the increase of personalized demand, the whole house customization has been favored by consumers because of its strong spatial adaptability, unified style and diversified functional design, and has become the mainstream trend of the home market. However, due to the increasingly fierce market competition, there are many problems in the traditional whole house customization mode: enterprises need to bear a large number of non-standard orders; disassembly, scheduling, production and installation process cumbersome; for consumers, there are often cases where prices are opaque, delivery cycles are long, and the final results are unsatisfactory.

From the perspective of manufacturing industry, personalized demand does not exclude mass production. The idea of mass customization believes that through the appropriate product structure and production mode, the effect of mass production can be achieved to meet the personalized needs [1]. Therefore, for the furniture industry, it is not to choose between 'standardization' and 'customization', but to find a balance between the two. The modular design is such a balance point: the cabinet products are decomposed into a limited number of standard modules for consumers to choose freely, which can not only ensure the characteristics of customization, but also maintain the advantages of mass production. It is a good solution.

1.2 Research Significance

The main idea of the modular design concept is to divide the complex furniture system into a series of small subsystems that are functionally independent of each other [2]. While introducing a new structure of the product line in the enterprise, it will also bring changes in the appearance of the product, the versatility of the parts, the richness of the product and the management of research and development. In the customized furniture industry, modular design can greatly reduce repetitive design work and preparatory work, improve work efficiency and service level.

In this paper, the change of whole house customized furniture from ' whole non-standard 'to' standard module combination + local precise customization' is studied.

2. The Development Dilemma of Traditional Full-custom Furniture Model

2.1 Limited Production Efficiency of Enterprises

Traditional full-custom furniture generally adopts' one household, one case, one single production'. Due to the space size, functional requirements, style preferences and installation conditions of each family are very different, so the enterprise can not form a stable production rhythm. After a large number of non-standard orders enter the production enterprise, the workload of dismantling, examining, blanking, edge sealing, drilling and packaging will increase, resulting in longer production cycle and more waste of materials.

Also see, full-custom furniture itself has a strong commercial characteristics. The enterprise should not only be responsible for the production of products, but also need to carry out tailor-made, design, negotiation, rescaling, installation and post-service. Due to the increasingly fierce market competition, product profits are constantly compressed, but the cost of services is difficult to reduce, which restricts the expansion and reproduction of enterprises.

2.2 Uncertainty in the Consumer Experience

From the consumer's point of view, although the traditional full customization can meet the individual needs of consumers, consumers face greater risks throughout the purchase process. First of all, the price is high, including plate, hardware, door panels, functional parts and installation costs and many other costs, it is difficult for consumers to distinguish whether these costs are reasonable. Secondly, it takes a long time. Full-custom products need to go through multiple steps such as design scheme determination, production, transportation and door-to-door installation, and problems in any link will cause delays.

In addition, traditional full customization has very high requirements for terminal designers. If the designer's understanding of space size, living habits and furniture modeling is not in place, there will be problems such as size deviation, unreasonable function and inconsistent style. Adjustment in the later period will not only increase the cost of the enterprise but also reduce the customer's experience.

2.3 The Development Mode of the Industry Needs to be Changed

In the period of rapid development of the industry, enterprises can obtain business orders by opening stores, doing marketing and providing design schemes. After the industry enters the stock market competition, this method has been difficult to support the healthy development of the industry. Excessive non-standardization reduces the efficiency of enterprises, and at the same time, it cannot allow enterprises to form unified product standards, service standards and quality standards.

Therefore, the whole house customized furniture industry should change from 'completely relying on non-standard design' to 'precise customization based on standardization'. Of course, this isn't about abandoning personalization, but rather using a modular approach to remove unnecessary work and focus limited customization resources on what's decisive for the customer experience.

3. The Basic Logic of Modular Standardized Customization Mode

3.1 The Connotation of Modular Design

The customization of the whole house furniture is mainly about the size of the space and the needs of the users. Modularization is to summarize the needs of users, divide them into several different functional modules according to people's height and item size, and specify the corresponding size of these functional modules under different room areas, and then splice them together to meet the basic requirements. Modularization can reduce the management workload of complex systems by using certain rules, so that each part can work independently and coordinately [3]. In the furniture volume, the cabinet structure, cabinet size, functional areas and so on can be modular.

Modular furniture is not a simple splicing, but a systematic design based on standard size, standard interface and standard function. Its main advantage is that a small number of standard modules can produce a large number of combinations, which can meet different needs at a lower cost. However, the whole house custom furniture in the full sense can not be achieved by modular design alone, and the necessary non-standard parts are also essential.

3.2 Relationship Between Standardization and Customization

The traditional thinking pattern regards standardization and customization as a contradiction. The former represents simplification and the latter represents complexity. However, mass customization focuses on realizing personalization under the premise of large-scale. On this basis, relevant scholars believe that different enterprises can choose appropriate customization methods according to the characteristics of their products to meet the needs of consumers at a lower cost [4]. In addition, the degree of customer participation and the degree of modularization of products also play a crucial role in whether mass customization can be carried out smoothly [5].

Therefore, furniture standardization customization needs to distinguish which parts should be standardized and which parts need to maintain customization flexibility, so as to increase the proportion of standardized parts in customized furniture.

3.3 The Operation Mode of 'Standard Module + Local Fine Customization'

The basic idea of modular and standardized customization of furniture is 'standard module combination + local precise customization', that is, most of the furniture is assembled by standard modules, and for some special sizes, irregular spaces, closures or added functions, etc., local precise customization is required to complete.

Even if a part is partially customized, it should be based on standard modules as much as possible. Under the condition that the function is unchanged, the standard module size can be appropriately adjusted to meet the space size requirements; for some special functions, the standard module construction method and the standard plate size are also used as much as possible. All in all, find the standard foothold in the non-standard, and perform functional superposition on the basis of the standard to meet the non-standard requirements.

It also needs to be seen that mass customization not only puts forward requirements for the manufacturing capacity of enterprises, but also cannot be separated from the support of information systems and user participation mechanisms, so as to accurately transform personalized needs into order information available for production [6]. Therefore, the standardized customization of furniture not only affects the product design method itself, but also involves the overall reconstruction of front-end sales, back-end production and service process.

4. The Application Value of Modular Standardized Customization

4.1 Pre-sales Service: Simplify the Pre-sales Service

Process and Improve Design Efficiency

The establishment of modular whole house custom furniture design system is to make the design more determined by customers. In terms of functionality, customers can choose the corresponding standard module according to their own needs, and then determine its function, size and appearance according to the designer's suggestions, so as to improve work efficiency. For the non-standard part, the secondary order form can reduce the workload of the designer's part of the measuring room and the scale, simplify the on-site operation process, and avoid the error problem caused by improper measurement.

4.2 Enterprise Side: Reduce Costs and Improve Production Efficiency

Modularization is conducive to reducing the non-standard proportion, so that the production process of the enterprise is smoother. Standard modules can be purchased in advance, mass production and centralized inspection, while some customized parts need to be produced according to customer needs. Mao Lei and Yan Chao believe that in the case of a large number of personalized orders, the furniture industry needs to develop a flexible production model from both design and production [7]. Therefore, in order to improve the productivity level of the furniture customization industry, it is necessary to abandon the traditional production mode that relies entirely on non-standardized parts. Moreover, modularization is also conducive to saving raw materials and ensuring product quality. Due to the high frequency of use of standard modules, it can better carry out cutting layout and mass production.

4.3 After-sales Service: Reduce the Difficulty of Installation, Improve the Efficiency of Installation

Compared with the traditional activity furniture, the installation quality and speed of the whole house custom furniture have a large gap. The reason is that its standardization degree is low. The unified structure and connection mode through modular design can achieve the installation effect of similar activity furniture, so as to speed up the installation speed and finally present the effect, and also reduce the later maintenance cost.

4.4 Consumer Side: Improve Cost Performance and Certainty

From the perspective of consumers, modular and standardized customization is conducive to price openness. The price of different modules is relatively clear. On this basis, consumers can choose according to their own needs, without worrying about the problems of ' unknown price ' and ' markup items ' encountered in the traditional customization process.

In addition, standard modules can speed up delivery in case of early production. For some common apartments and general use requirements, customers do not need to delay time because all products have to be redesigned and manufactured. Zhang Hui et al.proposed that modular furniture uses a unified interface to splice different modules, which not only reduces the production cost of the enterprise but also gives consumers more possibilities to choose [8]. Therefore, although modular standardized customization maintains a certain degree of flexibility, it also makes consumers more predictive of the results.

5. The Implementation Path of Modular Standardized Customization

5.1 Establish Module System

First of all, it is necessary to determine the module system according to the user's functional requirements and the size of the living space. Through the investigation of users, the commonly used functions, commonly used item specifications, general lifestyles, etc. are summarized as the functions and internal dimensions of the construction module; at the same time, the living space in a certain area is investigated, and the overall specifications and dimensions of the more common furniture are summarized, so that there is a certain proportion relationship between the different specifications and dimensions of a module, which is conducive to the application of the general standard module.

From the design point of view, for high-frequency, commonly used, fixed-function parts to try to achieve standardization. These modules should be the largest, easy to control the design side and user function selection, but also easy to site construction. At the manufacturing end, the plates with the same size and similar structure are separated as the standard module of the manufacturing end according to the design scheme. These modules should be the smallest, reduce the difficulty of factory production, save the cost of plates, and facilitate the realization of customized furniture standard plate inventory.

5.2 Unified Connection and Structural Rules

Whether it can be freely matched mainly depends on whether the interface is consistent. Furniture manufacturers need to unify standards for plate thickness, hole position, connection form, hardware size, door system and installation form of functional accessories. Only when the interface is consistent, the modules will cooperate well with each other and can be interchanged, and it will be more convenient in later maintenance or repair and local replacement.

5.3 Promote Digital Configuration

Enterprises should establish a module coding system to digitally manage the size, color, function, price and inventory of various modules. Through the module database and visual configuration tools, users can choose the room type, cabinet size, door panel style and function module, etc., and the system automatically generates the design scheme and quotation sheet. Relevant research on furniture intelligent configurator also proves that this configuration method can effectively promote the cooperation between custom furniture designers and manufacturers [9,10].

Digital configuration not only enhances the participation of users, but also enables enterprises to open up the chain from front-end sales to back-end production. The product module selected by the user can directly generate the bill of materials,

production list and installation list, reducing a lot of manual workload.

5.4 Reconstruct the Production and Installation Process

From the perspective of production, enterprises should adopt' standard module prefabrication + customized parts production by order'. The standard module can be produced in advance and then stored in the warehouse, and the custom parts are produced according to the customer's needs, which can not only speed up the delivery speed but also have flexibility to adapt to various space needs.

From the perspective of installation, we can adopt the workflow of 'first install the standard part, then install the local custom parts'. First, the standard module is installed on the construction site, and then the closing parts and some smaller parts are measured and manufactured, which is beneficial to reduce the size deviation and make the final product quality better.

5.5 Optimize the Service Mode

Modular standardized customization is not not not to design services, but to say that the design service focus is different. Designers can get rid of the heavy drawing work and devote more time to complex space processing, user life demand research and overall visual experience. General orders, customers through remote guidance or store staff can choose and combine the corresponding module; and more complex projects, you need specialized designers to further improve the design.

At the same time, enterprises must also have a standard service manual, in the measurement, order, review, delivery, installation and after-sales service are clearly defined. Service standardization is conducive to reducing the gap between front-line staff and allowing customers to have a better feel.

6. Development Trends and Suggestions

6.1 Shift from Full Customization to Precision Customization

Furniture customization in the future should no longer pursue 'all parts are non-standard', but should develop towards the direction of ' necessary parts are customized '. At present, the manufacturing industry has transitioned from mass production to mass customization and even personalized manufacturing. In this process, the participation of consumers has been increasing [11]. Therefore, for the furniture industry, it is necessary to use standardized products as the basis, and use local customization to meet the differentiated needs, so as to achieve high efficiency and good experience.

6.2 Shift from Product Sales to System Services

Modular, standardized customization is not just a product-level concept, but a service system. Enterprises need to establish a complete system around the module library, configuration system, flexible production and standardized installation. Li Xiaoli's research on the standardization of customized furniture also shows that the manufacturing of customized furniture can adopt the idea of modular design. On this basis, standard modules and unified interfaces are used to improve the interchangeability and versatility between parts [12].

6.3 Shift from Experience-driven to Data-driven

Traditional customized furniture is highly dependent on the designer's personal experience, and modular standardized customization requires strong support of data. The company should continue to precipitate the size data, user behavior data, module sales data and after-sales feedback data, and iteratively optimize the module library and size system accordingly. Relying on data-driven, enterprises can continuously expand the coverage of modules, improve the adaptability of products to various types of space, and better serve customer needs.

7. Conclusion

The traditional full-custom furniture model responds to consumers' demands for personalized space, but its disadvantages such as high non-standardization, strong dependence on service links, and low delivery efficiency have become increasingly prominent. Modular furniture customization is supported by standardized modules and supplemented by local precision production. It can improve production efficiency, reduce service costs and enhance the predictability of the consumer side under the premise of ensuring space adaptation and function satisfaction.

This paper proposes that the transformation of the furniture industry from full customization to standardized customization is not a weakening of personalized needs, but a reorganization of customization logic. Relying on module system construction, unified interface rules, digital configuration, flexible production and standardized services, enterprises can complete the transformation from' extensive customization 'to' precise customization'. Looking forward to the future, with the continuous progress of digital technology and intelligent manufacturing capabilities, modular standardized customization will become an important direction for the furniture industry to move towards high-quality development.

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