Apparel Mass Customization Technology Based on Postponement Manufacturing

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ABSTRACT:  Apparel mass customization can effectively meet consumers personalized, diversified needs and reasonably control production costs and delivery time, and the postponement manufacturing is one of its core strategies. Typical cases that garment industry applied postponed strategy into the production are introduced systematically, and present two key technologies-product differentiation delay and design production modularization. Delay product differentiation which is driven into production process by accurate information, avoids the drawbacks of forecasting relying on the experience, and modularization achieves large scale production as well as get the goal of customization. The postponed manufacturing theory, methods, cases, and implementation strategy in the apparel industry field have been explained systematically in order to provide new ideas and references for the apparel enterprises which are in the transformation and upgrading process to obtain core competitiveness and to open up new production business model.

1 INTRODUCTION

The personalized and diversified demand trends of consumer, which speed up the change of products, requires more elastic production, smaller quantities, more flexible and innovative sales channels while the increasing costs and the enormous industry competition. This phenomenon in apparel industry is much more obviously. What Chinese apparel enterprises are seriously faced with is a severe test including, due to the constantly improving costs of human resource and raw materials, demand with a slow growing rate, products with strengthening timeliness properties, and the sales channel innovation based on Internet. Apparel industry is experiencing the double tests of not merely costs but sales. Now the history data and experience had been unable to direct us to predict the apparel consumption demands accurately, meanwhile expanding the sales channel depends on the improving of marketing skills, especially the ability of products flexible pricing. Moreover, weak export demand, excess production capacity, as well as the rise of apparel industry in Southeast Asia and South Asia force Chinese traditional manufacturers to transit to the end-consumer market, all of which increased competition in the apparel retail industry.

Apparel production is transforming into varieties, small batch, and short delivery pattern since an increasingly discerning consumer habits and a pursuit of personality, popular, emotion and change for the consumer features. That means a requirement of flexible manufacturing and rapid response capacity for the enterprises. Although conventional production can reduce costs through the large scale production, it still be vulnerable to the effects of inaccurate demand forecasts and caused a lot of inventory, which is unable to meet diverse consumer needs; While customized apparel indeed meets the unique needs of each customer with the costs of high production investment, expensive pricing, long supplement period, customers’ waiting, and may be the temporal and spatial geographical limitations. The rapid response and the forecasting improvement methods indeed can contribute to enhancing performance for apparel enterprises, but it still cannot effectively resolve the contradiction of large scale production and product diversification. So, seeking to achieve these two parts balance becomes the focus of concern for the industry. Hence, to respond to the individual needs of consumers in the new period, to improve the brand competitiveness as well as to effectively control of production costs and retail prices, industry is usher in the era of apparel
Apparel mass customization (AMC) refers to a method that not merely own the efficiencies like the large scale production but also meeting the customized needs with both the price advantages of mass production and diversity for customized demands, which helps enterprises to arise the efficiency and profit (Cui et al., 2006). The main characteristics of AMC includes personalized customer-centric as a core, modular design and parts standardization as a foundation, rapid response as a feature (Pan et al., 2007).

There are many years for apparel mass customization theory and investigation research, from the conception and models to the business processes and technology (Xu and Liu, 2009), but a theory or case studies of feasibility and practical significance is still unavailable. Many ways are able to achieve mass customization, and the postponement strategy is considered to be a core theory to achieve mass customization. Specifically, the postponement strategy refers to a method delaying the all or some processes can be deferred of manufacturing, logistics, pricing and etc. and then to implement the next production process with accurate information until the customers’ demands are clear. If the pricing is not classified as a production activity, the postponement tactics can be divided into price-postponement and postponement manufacturing which is a comprehensive conception of an integrated manufacturing, logistics and inventory location (Qin, 2012).

2 CONCEPT OF POSTPONEMENT MANUFACTURING

Postponement is concerned as the effective strategy to meet consumer demand for personalized and to improve the efficiency usage of resource (Danuta and Artur, 2010). Postponement strategy was officially put forward in the 50s and 60s 20th century, and originally used in the production and inventory areas. with the development, the competition among individual enterprises turns to the competition among the supply chain. Partners in one supply chain need to collaborate in order to achieve system optimization, and supply chain under the postponement strategy has an advanced structure of a push-pull combination (Ma et al., 2002). Therefore, the study on postponement strategy attracted a widely spread attention till now. In practice many large companies, such as Hewlett-Packard, Dell, Benetton, Mercedes Benz, ZARA has made a successful application of the postponement strategy.

Postponement production model requires a standardized, modular and general intermediate product before the differentiation production and the production process and manufacturing activities are as unified as possible, which means to reduce the customized production process to ensure the large scale production. In this aspect, the leading enterprises Qingdao Red Collar Co. Ltd., their suit mass customization promotes the concept which allows customers to pick favorite patterns in the fabric sample brochure provided by the enterprise, and then to select their personal preferences collar, vent, pocket, cuff styles, button holes and other details of the suits. That is, to achieve the personalized performance within a certain range of restraints, under the guarantee of seven days delivery and reasonable prices. Obviously, postponement strategy can be a good solution of the conflict between large-scale production and individual needs.

Reebok can be regarded as a typical case successfully using postponement manufacturing to realize the apparel mass customization of the National Football League (NFL) replica jersey production and supply. To flexibly respond to the demand uncertainty and product diversification, and to increase customer satisfaction, Reebok achieved good operating results in the National Football League (NFL) replica jersey supply chain delayed strategy. Reebok, a season as a sales cycle, sets up a target of lowest the year-end inventory. Their explicit production processes are as following, as shown in Figure 1 (Fu et al., 2012): (i) Purchasing fabrics and accessories by Reebok. (ii). Cutting, sewing and garment assembly by the strategic cooperation manufacturers-some of these products will be printed on the players name and number, which is terminal product, and the remaining portion is blanked in the product name and number position. (iii) All blank jerseys (intermediate products) and printed jerseys (finished products) are transported to Reebok's North American distribution center in Indianapolis which is able to immediately print product on-site. (iv) When it’s accessible to accurate information of consumer customization needs, players name and number could be printed on the blank jerseys immediately based on consumer demands. Thus, companies increase sales of selling goods and reduce the risk of inventory risks.
Parsons (2004) firstly set forward this case to a systematic illustration. Fu et al. (2012) modeled it and expanded analysis of this issue. They set all replica jerseys printed on a certain star name and number into a same category. The number of categories depended on the number of stars, and almost every category faced an uncertain demand. Regarding the blank jerseys as the intermediate general products during manufacturing process and the printed jerseys as finished products, and when the demand information was clear, the intermediate product can be customized into any kind of finished products. Hence, the issue became a decision-making problem of intermediate and finished products stocking levels, which needed to minimize the total cost.

3 KEY TECHNOLOGIES OF POSTPONEMENT MANUFACTURING TO ACHIEVE AMC

3.1 Apparel product differentiation delay

Apparel product differentiation delay is the implementation technology of apparel mass customization, which refers increasing the common parts of production process to and apparel parts, delaying product differentiation links, and pushing apparel products customized time as much as possible by rearrangement of apparel production process and manufacturing technology. Specifically, product differentiation of postponement manufacturing involves two concepts: product differentiation point (PDP) and customer order decoupling point (CODP). Product differentiation point is the nodes from general form transition to more lower general form (Van der Vorst et al., 2001). Take fashion production as an example to explain the product differentiation point: the product through weaving, dyeing and packaging steps (that are PDP) shift to lower general and more specific market (Rijpkema et al., 2010). Another important point of product differentiation is CODP. It refers to a point of the manufacturing value chain at which the product associated with specific customer orders (Olhager, 2003). CODP was first used by Giesberts and Tang (1992) proposed. CODP divides the product logistics into two stages, before the CODP is the forecast-driven production activities, and after CODP is the order-driven production activities. After CODP proposed, it is widely used in postponement related to mass customization research. Current studies obscure the concepts of the PDP and CODP, both are called product differentiation points.

Apparel companies can achieve product diversification by postponement strategy in order to meet consumer demand for personalized products and lower ending stocks. The key technology is the reasonable control of costs, unified production and deployment of common parts of different products in the manufacturing process as much as possible, and delay the finished product or intermediate product differentiation process to the demand information further clear, promote the production process by accurate information, rather than rely on the experience and inaccurate predictions. Thus, the apparel enterprises in the use of large-scale manufacturing of customized production while achieving many advantages.

Apparel mass customization involves different customization, including modification customization, color and pattern customization, size customization, and style customization (Wu and GU, 2004). In the apparel industry, the first company using product differentiation delay is Italian Benetton, and has achieved good economic results. Benetton’s traditional production process is dyeing the yarns to various consumer preferences colors by forecasting and then weaving the yarns into the final product. However, this mode of production requires a very long time in advance to determine the product amount of various types of SKC, which could easily lead to deviation from the actual demand, resulting in some color product out of stock. While another part of the color products become inventory backlog, and have to be costly end-of-season sale. Thus, the Benetton apparel company change the yarn dyed first then woven into woven first then dyed, based on the transformation of the production process. As a result, the product of shaping operation is delayed until there is a genuine demand for supply chain information reprocessing (Shen, 2005), in order to increase sales of the best-selling products, reduce out of stock and inventory risk. Based on this concept of development, obtain differentiation postponement strategy of color and pattern customization, see Figure 2 (Wang, 2006).
As color and pattern customization of its custom is the dyeing process. In a typical apparel production process, printing and dyeing process situated upstream production processes and specific colors and patterns are predicted, so it can not fully meet consumer demand for color, pattern, pattern individual needs. Through the production process reengineering, the printing process is delayed until after the sewing step, so the companies determine staining pattern proportion and patterns closer to the sales period, so that the final products are more in line with customer preferences, helping increase sales and reduce inventory risk.

3.2 Modular design and production of apparel

Modular design aim is to increase production flexibility, rapid response of the final product, simple assembly capacity, it can be combined with many independent module to complete the assembly of the final product (Feitzinger and Lee, 1997). Modular design principles include: spare parts standardization and modular postponement. Parts standardization refers to the product standardization of spare parts, which is making spare parts in the front of the supply chain be for more generic, and delayed product differentiation points. Modular postponement is delaying the point of difference components and modules generated after the extension to make it closer to the client. This policy will delay the product assembling to regional distribution centers to shorten order cycle. So modular design and production is the premise and guarantee of product differentiation postponement.

In the apparel mass customization mode, the product is customer-centric customized production. In addition to requiring enterprises with high rapid reaction capability and level of information, the product design and production modularization is the guarantee of scale economy of mass production. The purpose of modularization is to increase the modularity of similarity or commonality of local production process design, parts and production processes. The apparel product is divided into relatively independent parts, that is the module, thereby reducing internal diversity and increasing external diversity. Apparel products can be broken down into various local structures, local structures have corresponding style designs, and the local structures can be further broken down into various clothing pieces, each piece have corresponding model. Deconstruction of apparel products and serialization and standardization of local structures are the main contents of apparel mass customization design and production.

Take suit customization for the example of design and production modularization to analyze the process of modular apparel product. Suit jacket structure can be divided by major body, collar, sleeves, towel pocket, waist pockets, inner pocket and card pockets. These modules can be further subdivided, such as large body can be divided into facing, left cut-part, right cut-part, back cut-part, armpit cut-part, placket button other sub-modules. After dividing by modular, each module can be established for customers to choose the style library, such as the type of collar, button number and location of placket, the type of facing, etc. (see Figure 3). Similarly, fabrics and accessories can also be modular division. By combining with different modules, it can produce a variety of suit styles to meet the needs of different consumers.
the number of modules and styles is too few, it unable to meet the individual needs of consumers, resulting in loss of customers. On the contrary, if the number of modules and styles too many, although it meets customer requirements for product design, but the production process is too complex to be reached large-scale production, resulting in product price is too high and extended delivery, which will also lead to a decline in customer satisfaction.

4 CONCLUSION

As people continue to pursue individuality and fashion, diversification trend of apparel, which is the representative of the fashion product, is more and more significant, and the rate of product change is more and more accelerating. That all potentially exacerbate the difficulty in forecasting consumer demand, while the single piece customized production which although meets the customer's personalized demands, is at cost of high production investment and a longer delivery time with a limited market space. Apparel mass customization can effectively solve the problem based on the postponed manufacturing, through which product differentiation is delayed until all or parts of the customer demanding information is clear. Customization and large scale production satisfy the needs of customer preferences and the control of production costs, separately. This article describes apparel research status and typical cases of the postponement manufacturing in apparel mass customization field, and puts forward the key technologies to achieve apparel mass customization by postponement manufacturing-apparel product differentiation delay and design and production modularization. The theory, methods, cases, and the implementation strategy facing to apparel industry have been interpreted systematically one by one, in order to provide valuable guidance and reference for those apparel enterprises who are interested in the practice of apparel mass customization.

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