Research on Garment Mass Customization Architecture for Intelligent Manufacturing Cloud

Li Zhe[1], Di Tao[2*], Tian Huan[3]

[1]Chinese Academy of Lifestyle Design, Beijing Institute of Fashion Technology, Beijing, 100028, China
[2]Department of Mechanical and Electrical Engineering, Lanzhou Vocational Technical College, Lanzhou, 730070, China
[3]Department of Electronics and Information Engineering, Lanzhou Vocational Technical College, Lanzhou,730070, China

Abstract. The deep integration of Internet, intelligent manufacturing and big data technology has promoted the development of products to be networked, digital, intelligent and personalized. The rapid iteration and differential segmentation of consumer demand has spawned new personalized consumer demand, transforming the traditional manufacturing model into a service-oriented manufacturing model. This paper analyses the large-scale customized operation mode of domestic and foreign clothing custom brands. In view of the transformation of traditional clothing industry, this paper proposes a solution to establish a large-scale custom clothing architecture under the vision of intelligent manufacturing cloud platform technology. This paper uses data mining and cloud computing and other methods to build an "Internet + manufacturing" innovation model with rapid collaboration under the umbrella of big data, and propose an architecture for mass customization of clothing, providing effective solutions and strategy recommendations for the transformation and upgrading of the traditional apparel industry.

1 Introduction

The traditional production mode is that the designer designs the popular styles according to the forecast. The enterprise purchases raw materials such as fabrics and accessories in batches, and mass-produces the garments according to the specification standards or free codes before the arrival of the season, and pushes them to the market, waiting for the customers' choice. Such products are identical except for simple colour and specification changes, and are influenced by the designer's personalization and cultivation. This production method of mass production of the same garment is most suitable for a stable and uniform clothing demand market.

With the rapid development of the economy and the continuous improvement of people's living standards, people's consumption concepts have gradually changed. People's functional requirements for clothing have turned into functional and emotional needs, and fewer and fewer consumers have the same style, fabric, and size requirements. At the same time, consumers want to get personalized clothing with short delivery times, and the price gap is smaller than that of mass-produced clothing. Therefore, the living environment of large-scale clothing manufacturers is gradually losing. The production of traditional tailor-made workshops obviously cannot meet the needs of consumers. Some powerful companies are striving to respond quickly to the personalized market with multi-variety and small-volume production methods, but the results are not satisfactory, because this is still a production method that designs and produces according to predictions in advance and does not fully express customer personality. Design and production costs are high, and new products are quickly "replicated" by small businesses. The traditional large-scale garmentization model can no longer meet people's growing individualization requirements. The consumption concept represented by diversification has brought a new round of growth momentum to the Chinese garment industry. The traditional garment industry has entered an unprecedented transition period.

2 Research Status and Development Trend of Garment Mass Customization Mode

If a clothing company can find a production method that meets individual needs and has fast and low cost, it can increase profits and survive and develop in a fiercely competitive environment.MC, Mass Customization is one of the effective production methods.[1] The term "mass customization" first appeared in the 1970 book of the prophet Alvin Toffler's book "The Shock of the Future".[2] In 1993, Joseph Pine II gave a complete description of the concept of mass customization, but until It has only been valued by people in recent years. [4] Mass customization was first used in the mechanical manufacturing industry and was gradually extended to other industries. The successful implementation of Levi Strauss & Co.'s mass-customized Personal Pair brand

*Corresponding author's e-mail: 120839127@qq.com

jeans proved that the production method is equally applicable to garment manufacturing industry.[5]

Mass customization of clothing is an advanced production and management mode of garment enterprises that integrates garment enterprises, customers, suppliers and the environment, and makes full use of the latest research results of human beings in various technical fields. [6] One of its core ideas is to require apparel companies to produce personalized clothing at times and costs similar to mass production. First of all, it is a theory that guides garment enterprises to participate in market competition. [7] It requires garment enterprises to consider the relationship with customers from the perspective of long-term interests, and "customer satisfaction" is one of the highest pursuit goals to attract and "permanently" retain customers. Secondly, it is a way for garment enterprises to organize and manage production. It requires enterprises to provide customers with any variety and quantity of clothing at a speed, cost and quality similar to mass production through rational allocation of resources and optimization of operation process. Third, it is a guideline that guides designers in custom product design, requiring designers to take into account the individualized variants of the garment during the design process.

2.1 Domestic research status and development trends

China's clothing customization industry dates back to Ningbo's "Red Gang Tailor", which originated in Yokohama, Japan.[8] In 1896, the first suit shop "He Chang" was opened in Shanghai, and shops were opened in Guangzhou, Ningbo and Harbin. "Red Gang Tailor" combines Western advanced crafts with traditional Chinese craftsmanship to make an important contribution to the formation and development of modern Chinese clothing.[9] The Chinese clothing custom industry originated from the red tailor tailoring, and the hand-stitched suit customization began to evolve and evolve to form a modern clothing custom industry. [10] At the end of the 20th century, China's garment industry developed rapidly, and the custom industry went down. With the development of information technology and consumption upgrades, traditional large-scale mass production of garments could not meet the needs of consumers to personalize the pursuit of high-quality products. [11] The clothing customization industry has once again become the slogan of the development of the garment industry in a diversified form.

The development of China's garment industry has gone through three stages. [12] The first stage is tailor-made for the traditional costumes of the red gang tailors, such as Long Qingxiang, Hongdu, Yongzheng Tailor, Zhenzhifu, Hong Kong Shige and other 100-year clothing custom brands. They follow the traditional red gang tailoring process, using pure hand-stitching, making High cost and long cycle. The second stage is Internet + clothing online customization, such as Yibang people, Evo launched "easy tailor" online customization, Da Yang launched YOUSUKU online custom brand and other network custom brands. The third stage is Internet + digital intelligent manufacturing, such as Red Collar, News, etc., through the 3D printing logic, to achieve a data-driven industrial Internet customization platform for the Internet + manufacturing industry, transforming the traditional complex supply chain into information-driven electronics.[14] The supply chain system realizes large-scale digital personalized customization of clothing.

2.2 Status and development of foreign research

Foreign clothing network customization started earlier. With the rapid development of e-commerce, each customized enterprise has established a one-stop platform for customizing the clothing of designers, fabrics, factories, physical stores, logistics and consumers. [15] With the rapid development of digitalization and intelligence, clothing custom brands such as “Bonobos”, “Indochino” and “Constrvct” have launched digital personalization based on the Internet.[16]

The largest clothing brand in the United States, "Bonobos", custom products include men's pants, suits, shirts and shoes. "Bonobos" adopts the "vertical integration, multi-channel retail" online and offline virtual and integrated business model, in addition to giving customers a better customized experience, customers have three channels to place orders, including Online (Website), Guide shop (experience store), physical department store. [17] Customers can choose and try on the clothing, and select the custom styles and fabrics of the clothing on the online platform. After the quantity is directly placed, the customer data product information is converted into digital transmission to the production department to realize the production → distribution → customer's full Quick customization of the supply chain.

Canada's custom-made leader "Indochino" provides customized services for mid- to high-end online personalized suits. Customers can customize their own clothing by visiting the online mobile terminal or offline stores in New York, Boston, San Francisco, Toronto, Beverly Hills, Philadelphia, and Vancouver. "Indochino" uses a virtual inventory business model, mainly through online sales, in the form of Travelling tailor to provide customers with offline experience. The customer selects the garment fabric, style and other independent design, and then directly transfers the data to the factory for production.

Fashion custom technology innovator "Constrvct" is a customized online clothing brand in the United States. The brand launched the industry's first online software for 3D fashion design. Customers can present the 3D map of the entire garment through the 3D design interface, and design and produce the garments that are completely unique to their own original trends. Customizers can upload their favorite high-definition photos, paintings, etc. to the "Constrvct" website, use 3D design software to design their own pictures, and then choose the fabrics, styles, patterns, etc. of the clothing, and then place the order through the independent volume.

The data is transferred to the production department for production.

Digitalization and intelligent customization are the inevitable trend of the development of the manufacturing industry. [18] They are also one of the important contents of the "China Manufacturing 2025", the German "Industry 4.0" and the US "Advanced Manufacturing Strategy Plan" and other national strategic plans. With the continuous upgrading of production and demand levels, the development of digital technologies such as CAD, ERP, 3D scanning, MTM, and virtual fitting, the future apparel industry is moving toward digitization and intelligentization.[19]

3 Design of clothing mass customization architecture based on intelligent manufacturing cloud platform technology

3.1 Application prospects of intelligent manufacturing cloud platform technology in the field of clothing mass customization

With the development of Internet technology, cloud platforms, big data, and artificial intelligence have dramatically changed the way of life production in modern society. The trend of informationization in social development has become more prominent. Information technology has been the main driving force to promote the transformation of social productivity. Continue to develop in width and depth. Cloud platform technology is an important driving force for the transformation and upgrading of various industries. The application of Internet thinking in various industries has gradually turned into a business model innovation. Therefore, Internet technology has also become an important driving force for promoting the transformation and upgrading of various industries in China. The wide application of Internet communication technology affects the development of new business models and business thinking. Especially under the conditions of mature information technology, "big data thinking" has emerged. The Internet can be said to be the creator of big data thinking. Only when the Internet information technology is fully mature can new big data thinking be derived. Cloud platform technology is the key to current development and innovation. It can directly show the problems that occur in the enterprise, and then use the Internet information technology to effectively solve it. It can meet the needs of the market and provide users and enterprises with the most direct solution. Big data thinking is first applied by Western countries. As a key point for future development and innovation, it is not available in the Internet itself. With the help of the Internet, you can effectively find problems and then use big data thinking to solve problems. This way of solving problems is predictable.

Under the cloud platform technology perspective, the Internet and big data thinking are complementary. With the help of the Internet, big data thinking will be more convenient. Big data thinking can make up for the shortcomings of the Internet's lack of predictability, and the Internet can also supplement the problem of discovering the market status that big data thinking does not have. The Internet can play a major role in current innovation, and big data thinking can play a role in the future. In the era of intelligent manufacturing cloud platform technology, the focus of corporate competition has also undergone a major transformation. Using the analysis of big data can effectively grasp the dynamics of the market and then make effective responses; it can provide decision support more accurately and effectively; it can also help enterprises to provide consumers with more timely and personalized services. The development and innovation of the Internet and big data thinking can better help companies solve many problems.

Through the analysis of the existing clothing customization model and the research on the customized transformation trend of the traditional clothing industry, it is found that the Chinese garment industry faces problems such as unreasonable supply relationship, low innovation ability and serious product homogeneity. In order to find a path that is more suitable for the development of the clothing customization industry, actively explore the characteristics of clothing customization, the advantages of intelligent manufacturing cloud platform technology, and the feasibility of mass customization of clothing under the thinking of big data. Combined with the characteristics of mass customization of clothing, we continuously integrate intelligent manufacturing cloud platform technology, establish a new customized architecture, and create a more complete service system. The customized platform establishes "fabric library", "pattern library", "style library", "database" and "service plate" through big data thinking, etc., to improve the shortcomings of the original custom cycle, complicated procedures and high price, so that the clothing Customization has changed to convenience and popularity. To meet the needs of today's social and economic development and the diversity and uniqueness of people's consumption, balance the relationship between supply and demand from the root. In the production mode, the flexible production chain is built, the original production supply mode is abandoned, and the problems such as inventory are avoided, thereby reducing the cost and increasing the productivity.

This article will focus on the combination of clothing mass customization and intelligent manufacturing cloud platform technology, and explore the development model of the apparel industry and the development trend of clothing mass customization under the big data thinking. Promote clothing customization In the environment of industry transformation, consumption upgrading, and social transformation, the use of Internet technology to upgrade the business structure to adapt to the trend of personalized customization, and continue to promote the transformation of the Chinese clothing industry towards customization.

3.2 Garment Mass Customization Architecture Implementation Path

Mass customization of clothing based on big data thinking is the trend of the times. Digitalization, intelligentization and synergy are the key. Mass customization of clothing not only needs to meet the individual needs of customers, but also collects consumer demand through online and offline omni-channel, and realizes product standardization and modular rapid production through digital processing and classification. Informatization, digitization, and intelligentization are injected into the production process of the enterprise, and the enterprise supply chain is optimized to reconstruct and upgrade the business model. The most important thing for enterprises to develop personalized customization is the combination of technology and digitization technology, such as 3D scanning, virtual fitting, and human body model intelligent printing. The survey shows that the potential market demand for China's customization is large. Therefore, enterprises should establish a customized platform, an integrated platform for the integration of all categories of products, and a customized platform with different levels of omni-channel, and expand the category through the industry vertical T-shaped strategy to create a national customization.

The technical problems of large-scale customization of clothing can be solved by intelligent manufacturing production technology, but the key of customized platform is to take consumer demand as the source, adhere to the principle of customer first, experience as king, pay attention to customer needs and respond quickly to customer needs. [20] Increase customer sharing and participation, increase customer stickiness and enhance brand image. Through big data to drive the collaborative manufacturing of various systems, accelerate the deep integration of the Internet and industrial production, and optimize and upgrade the manufacturing methods.

3.3 Clothing Mass Customization Theory Architecture Framework

Building an apparel mass customization system for smart manufacturing cloud platforms requires attention to the following key issues:

- Solving the problem that the multivariate variability and ambiguity of the clothing demand market is difficult to quantify;
- Solving the problem of model standardization of clothing mass customization and modular design;
- Solving the problem of intelligence and synergy of personalized design of clothing mass customization;
- Solving the agility and integration problems of garment mass customization;
- Solve the problem of weak correlation between clothing customization points and subsequent processes.

Based on this, this paper proposes a basic architecture framework for mass customization of clothing based on the research of mass customization of clothing. It consists of four parts: theoretical foundation, engineering technology, management method and implementation goal. (figure 1)

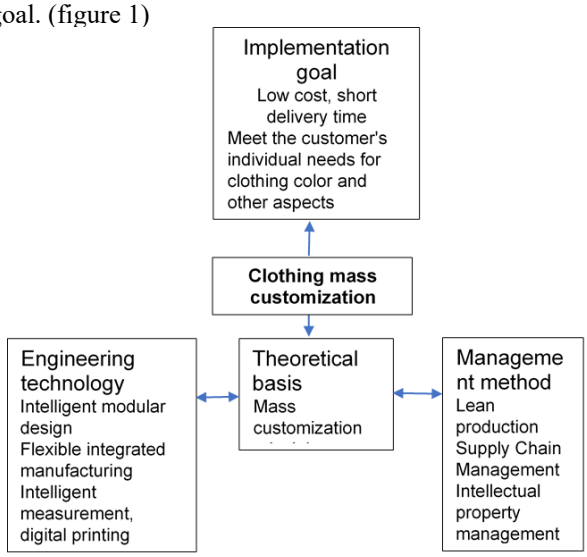

Figure 1 Architecture of the mass customization theory of clothing

4 Apparel Mass Customization system Architecture Driven by Intelligent Manufacturing Cloud Platform Technology

Using the company's existing production technology, through the integration and interoperability of Internet technology with APS, MES, ERP, CAD, SCM and other systems, to achieve intelligent and personalized flexible production within the factory. Taking the customer order information as the wire and the RF chip card as the carrier, the 3D scanning, virtual fitting, and human body model provide customers with personalized service, and the people, machines, materials and materials in the apparel customized production cycle are transformed into data information. Automatic identification of identification technology, organic integration of various systems and networks in the unified digitization platform of the Internet of Things, forming a standardization module integrating intelligent manufacturing platform, cloud platform and customer information platform, focusing on marketing, products and informatization. The integrated application of the organization enables a highly efficient, low-cost production execution system.

By investigating the socialization of apparel mass customization under the background of intelligent manufacturing cloud platform technology, the concept of mass customization of clothing is studied, and the basic characteristics of clothing mass customization are analysed, including the multiple variability and ambiguity of clothing demand market, and individualization. The design characteristics of clothing, the agility and integration of garment mass customization, the weak correlation between customization points and subsequent processes, etc., and the strategy of personalized clothing selection strategy under big data

thinking. Finally, the basic form and architecture of apparel mass customization were constructed, and the general mode of mass customization of big data-driven clothing was formed (Figure 2).

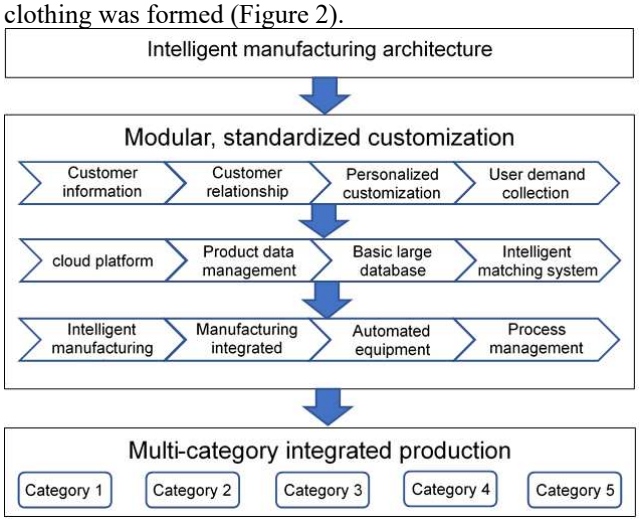

Figure 2 Architecture diagram of apparel mass customization application based on intelligent manufacturing cloud platform

Its basic form consists of three levels:

First, the data cloud ecological centre. Through CRM customer relationship management system to manage consumer data, body shape, wearing habits and other data, to provide further personalized services in the precise way of big data, to achieve accurate marketing of big data. The use of sharing big data platform, support designers and small and micro enterprises to start business, open and share with the relevant parties in the industry chain, strengthen the coordination and cooperation of the industry chain, open up the upstream and downstream ecological industry chain, and achieve interconnection and cooperation with related parties.

Second, apparel customized cloud platform. Through the omni-channel e-commerce platform, the application of virtual reality simulation technology and 3D rendering technology, build a customer information integration management system such as PLM, CRM, SCM, etc., realize the integration of industry and commerce with the mode of direct connection manufacturing and online and offline, in MTM mode. A modular omni-channel service model that implements online collaboration and one-person version and one dress.

Third, intelligent manufacturing production platform. Through the PLM product life cycle management system and intelligent CAD system to build a smart version of the model library, standardization, component automation and intelligent modification of model parameters, development of intelligent scheduling system, implementation of advanced plant production planning, and intelligent scheduling using visualization technology Track production schedules and adjust production schedules in real time. After receiving the information such as the order, material, layout, and process, the CAM automatic cutting system realizes one-piece automatic cutting of one piece. That is to achieve flexible production of products through intelligent manufacturing, especially in the production process, using software to form data to drive the overall operation, through the intelligent flow of data, break the time and space constraints, optimize resource allocation, and drive each The high-speed operation of the link enables full tracking.

4.1 User-oriented apparel mass customization architecture

The enterprise-oriented apparel mass customization model based on intelligent manufacturing cloud platform technology transforms the entire custom consumption and supply chain process. Consumers lead customers to place orders through online platforms or offline stores. Platforms or enterprises use customer orders through the Internet. Transfer to individual designers or companies, and personalized customization according to consumer needs, to achieve zero inventory, low cost, high efficiency production (Figure 3). As consumer demand continues to escalate. Make this model better adapt to the current development trend of the market. Enterprises develop customized platforms based on their own situation, and assemble designers or enterprises to build customized platforms. Customers connect directly with companies or designers through the platform to establish one-to-one personalized services. This model removes the middleman link and directly connects the consumer terminal to the producer to provide a new Internet+ solution for traditional enterprises. The core of this model is to create high-efficiency personalized customization, using big data and cloud computing technologies, transforming scattered customer data requirements and data sets into production data, and using intelligent manufacturing technology to transform the production organization process of enterprises and realize mass customization of clothing.

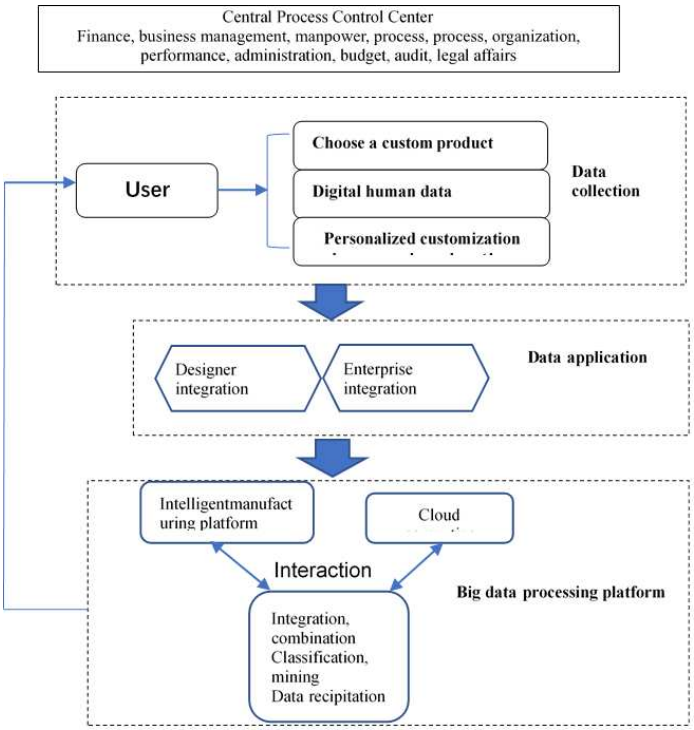

Figure 3 User-led apparel mass customization architecture based on intelligent manufacturing cloud platform

4.2 Enterprise-led apparel mass customization architecture

The deep integration of Internet technology, cloud computing, intelligent personalized flexible production and enterprise-oriented apparel mass customization system has broken the contradiction between large-scale production and personalized customization of clothing, and realized mass customization of clothing based on intelligent manufacturing cloud platform technology (Figure 4). This model combines fragmented individualized requirements with modern information processing technologies such as big data technology and cloud computing technology. By intelligently manufacturing the personalized needs of Manchu Volkswagen, the supply chain is quickly responded to achieve customer scale effects.

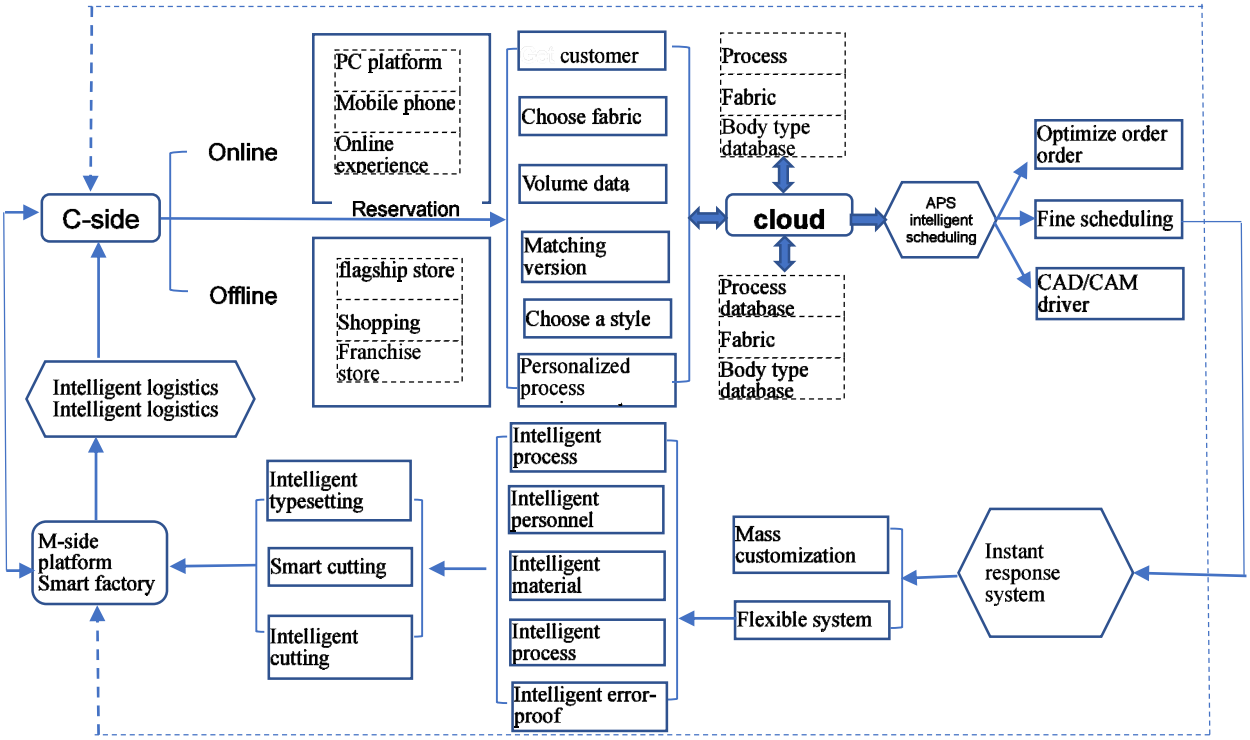

Figure 4 Based on intelligent manufacturing cloud platform enterprise leading apparel mass customization architecture

Through the collection of personalized consumer demand, low-cost and high-efficiency intelligent production, that is, standardized and unified production, the key to restricting the mass production of apparel mass customization is the production and design of garments. The cloud platform collects and builds the database and fabric database, style database, process database, etc., the style data and clothing pieces establish a one-to-one correspondence, through continuous update and optimization to achieve version data, modular. Quickly and effectively collecting customer needs and physical information, and quickly matching the response database, is the key to the beginning of apparel mass customization. In the apparel mass customization, the company upgraded the traditional production line to a production line based on intelligent manufacturing cloud platform technology. The workers produce according to the real-time data of the customer's needs, and finally realize the products of the Manchu customized individualized demand in the same assembly line. The intelligent manufacturing cloud platform technology finally realizes mass customization of clothing by effectively reorganizing each module.

5 Conclusion

At present, there are certain researches on the integration and development of apparel customization and Internet technology at home and abroad. The theoretical innovations in this paper mainly focus on the research of a customized model, nor the exploration of a custom system, but a set of Complete service system architecture. Based on big data thinking, the establishment of "fabric database", "process database", "model database", "version database", "body database" and "service segment" will simplify the apparel customization process of clothing, reduce the customization cost, and customize The shortening of the cycle has prompted the customization of Internet-based clothing to become more popular, allowing more people to experience the humanized service brought by clothing customization. From the business model, the characteristics of apparel customization and the advantages of the Internet are combined, and the innovative customization mode provides consumers with customized business options such as customization, micro-customization and designer integrated brand products. In production, the application of flexible supply chain solves the problems of high inventory and unreasonable relationship between supply and demand in the garment industry. The mass customization production adapts to the diversity characteristics of today's market demand.

The apparel mass customization system for intelligent manufacturing cloud platform proposed in this paper can effectively gather the innovation potential and wisdom of the majority of fashion designers and individual users, and actively guide the individualized development. This fashion design featuring individualized needs the system has a positive promotion and guiding significance for the future development direction of the entire garment industry. Subsequent research will use the Internet technology, modern communication technology, cloud computing and other cutting-edge technologies to establish a collaborative technology platform for the service apparel industry. How to deal with the personalized mass data collected by the platform, and how to choose to accept relevant apparel companies, brand design companies, personal designers and individual users to join the platform, and become a cloud customization of apparel mass customization system for intelligent manufacturing cloud platform. In part, these issues are for further study.

Acknowledgments

Thanks for the following fund for supporting this article: Special Fund for Building High-level Teacher Teams in Beijing Institute of Fashion Technology-----Scholar Program of Beijing Institute of Fashion Technology. (Fund Number: BIFTXZ202003)

References

1. Pine B Joseph. Mass Customization - The New Frontier of Enterprise Competition [M]. Beijing: China Renmin University Press, 2000.
2. Li Renwang et al. Preliminary study on mass customization and its implementation methods [J]. China Mechanical Engineering, 2001 (4): 405~408 .
3. Liu Yunhua, Yan Liangyun. Red gang tailor source test [J]. Journal of Textiles, 2008, 29(4):104-107.
4. Zhu Weiming, Xie Qin, Peng Hui. Men's suit digital intelligent tailor-made system development [J]. Journal of Textiles, 2017, 38 (4): 151-157.
5. Zhu Weiming, Peng Hui. Research on the pattern and operation mode of China's custom apparel brand [J]. Silk, 2016, 53(12): 36-42.
6. Li Wei. The influence of customization factors on manufacturing time in mass customization environment and model research [D]. Chongqing: Chongqing University, 2014.
7. King C W，Sproles G B. The explanatory efficacy of selected types of consumer profile variables in fashion change agent identification［M］. Institute for Research in the Behavioral，Economic，and Management Sciences，Purdue University，1973.
8. Murray J B. The Politics of Consumption: A Re—Inquiry on Thompson and Haytko′s (1997) "Speaking of Fashion"［J］. Journal of Consumer Research,2002，29 (3) : 427-440.
9. Workman J E, Johnson K. Fashion opinion leadership, fashion innovativeness, and need for variety［J］. Clothing and Textiles Research Journal,1993,11(3) : 60.
10. Joachimsthaler E, Aaker D A. Building brands without mass media［J］. Harvard Business Review,1997,75: 39-41.

11. Basole, R. C., & Nowak, M. (2018). Assimilation of tracking technology in the supply chain. Transportation Research Part E: Logistics and Transportation Review, 114, 350–370.
12. Attaran, M. (2017). The rise of 3-D printing: The advantages of additive manufacturing over traditional manufacturing. Business Horizons, 60, 677–688.
13. Choi, T. M. (2018). Incorporating social media observations and bounded rationality into fashion quick response supply chains in the big data era. Transportation Research Part E: Logistics and Transportation Review, 114, 2018.
14. Choi, T. M., & Guo, S. (2018). Responsive supply in fashion mass customisation systems with consumer returns. International Journal of Production Research, 56(10), 3409–3422.
15. Çil, E. B., & Pangburn, M. S. (2017). Mass Customization and Guardrails: "You Can Not Be All Things to All People". Production and Operations Management, 26(9), 1728–1745.
16. [16] Huber P, Kopp P, Christmas W, Rätsch M, Kittler J (2017) Real-time 3D face fitting and texture fusion on in-the-wild videos. IEEE Signal Process Let 24(4):437–441
17. Jevšnik S, Stjepanovič Z, Rudolf A (2017) 3d virtual prototyping of garments: approaches, developments and challenges. J Fiber Bioeng Inf 10(1):51–63
18. Xie X, Livermore C (2017). Passively self-aligned assembly of compact barrel hinges for high-performance, out-of-plane mems actuators. In: Micro Electro Mechanical Systems (MEMS), 2017 I.E. 30th International Conference on. IEEE, pp 813–816
19. Hogg, M. A., & Terry, D. J. (2017). Social identity and self-categorization processes in organizational contexts. Academy of Management Review, 25(1), 121–140.
20. Zaggl, M. A., Hagenmaier, M. A., & Raasch, C. (2018). The choice between uniqueness and conformity in mass customization. R&D Management. https://doi.org/10.1111/radm.12327.