

Preliminary Study on Personalized Customization Service Platform Based on 3D Printing Technology*

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Abstract—As 3D printing technology becomes increasingly mature, the restrictions on product design and research and development as posed by material processing technology are greatly reduced, so that product design and research and development becomes intelligent, and can meet people's ever-increasing functional requirements more quickly and efficiently. At the same time, the process and organizational form of product research development also changes dramatically with the huge change of 3D printing in additive manufacturing process. Based on the processing characteristics of 3D printing, this paper explains the product research and development process, modeling characteristics, and the opportunities it brings for personalized customization. It further explores the framework and ideas of personalized customization service platform based on 3D printing technology to provide new ideas for innovative development of 3D printing equipment manufacturer.

Keywords: *3D printing technology, design process, personalized customization, network service platform*

I. INTRODUCTION

With the widespread application of 3D printing and technology, the industrial product market has gradually shifted from mass production to single production and personalized customization of product samples. Compared with traditional manufacturing process, the production form based on additive manufacturing greatly improves the progress of product research and development and saves research and development cost. It can be said that the rapid sample production service of products based on 3D printing technology has occupied a considerable proportion and economic benefits in the market. In the context of the Internet and 5G cloud services, it is possible to make use of 3D printing manufacturing technology to provide personalized customization services, provide new development ideas for relevant platform, 3D printing equipment manufacturers and its upstream and downstream industrial chains. By innovative transformation and application of this technology, it is available to provide small number of personalized products that can be better incorporated in people's lifestyle, for design, development and promotion of the product, and further promote the

industrial development and economic growth.

II. PROCESSING CHARACTERISTICS OF 3D PRINTING

From the point of view of product manufacturing methods, traditional industrial product processing and manufacturing technologies mainly include equal-material manufacturing and subtractive manufacturing. Equal-material manufacturing is to produce a product into shape by machinery casting, forging, cutting, welding and the like processing techniques where the weight of the production material is basically not changed in the manufacturing process. Subtractive manufacturing is to produce a product into shape by removing or cutting materials in ways of turning, milling, planing, grinding and etc. on a machine tool. The target forms obtained by the two manufacturing methods are product assemblies shaped by stamping molding, plastic molding, etc., and finally assembled into a complete product. From the perspective of the molding method, whether it is shaped by stamping or plastic molding, due to the requirements of product mass production efficiency, all product components must be simple in structure, rational in processing technology and scientific in manufacturing as much as possible to facilitate processing, stamping, plastic sucking and de-molding, and finally assembled into tens of thousands of standardized products and enter the market after being tested as qualified. However, this process takes a long cycle and high cost, so that the characteristics of the product form lag behind the development of industrial technology and form a bottleneck for the development of product form.

III. PRODUCT DESIGN PROCESS BASED ON 3D PRINTING

The traditional product design process is relatively complicated. The first is that an enterprise determines a certain demand in the target market and conduct the conceptual development of one or many product(s) according to its long-term development strategy and economic goals. Then, it defines the product system and modularizes the product. After determining the product concept, it will make detailed design for the new product. After the preliminary work, the enterprise generally may provide several pre-production programs for various instruments or users to test and evaluate the product and then adjust and improve the program again. During the product start-up phase, the enterprise should on the one hand solve the remaining problems in the production process and on the

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other hand provide the trial product customer to find out the defects and deficiencies existing in the product. Based on the feedback information, the enterprise should revise the product again to make the final improvement for mass launching the product into the market. This process is complicated and tedious. Therefore, in order to increase the speed of product research and development, many companies will try the best to shorten the research and development cycle and think about the flat production process to make their products quickly occupy the market.

However, 3D printing changes the general process of traditional product design. The 3D printing manufacturing system is more targeted and belongs to decentralized manufacturing system. The target users of such products are more subdivided and the production scale is small. Under this premise, the product positioning can be very clear. As long as the data of specific target customers is collected in the initial conceptual design stage, it is available to determine the product details, reduce the repeated testing and evaluation links, and get the product directly delivered to the target customer. Therefore, the design process by manufacturing system based on 3D printing is flatter and more directional, which greatly shortens product research and development time and improves the product research and development efficiency.

IV. PRODUCT MODELING FEATURES BASED ON 3D PRINTING TECHNOLOGY

As 3D printing technology becomes increasingly mature, the appearance of product modeling has ushered in spring. The additive manufacturing method of 3D printing technology is a perfect complement to subtractive manufacturing and equal-material manufacturing and can make up for the shortcomings and defects of the two previous processing methods. Therefore, the product modeling based on 3D printing technology shows various characteristics and advantages: namely, the product appearance and framework becomes integrated with the internal structure and the product modeling and decoration becomes diverse.

Many seemingly simple products, in fact, have complex internal structures and even have hundreds or thousands of parts. In addition to satisfying the necessary functions, they are mainly used for fixing and connecting between parts. 3D printing technology can not only be used for connecting product parts, but also ensure the security reinforcement on the premise of ensuring the product functions. For example, the world's first 3D printed small airbus aircraft was unveiled at the Berlin International Air Show in June 2016. Surrounded by a number of giant jets, Thor looked very small, had no windows, weighs only 21 kg and is less than 4 meters in length. 3D printed metal parts are 30% to 50% lighter than the parts produced in the past, which realizes almost zero production waste. The only part that does not use polyamide materials for 3D printing is electronic component. Some experts said that in addition to saving costs, 3D printing can also bring ecological benefits, because as weight decreases, jets may use less fuel and emit fewer pollutants.

For example, LuxCreo released its self-developed high-performance elastic material EM-11 that can be used for mass production in October 2018. The material has exceeded the previous key performance indicators such as tensile strength, elongation at break, tear strength, rebound rate, and bending resistance, and fully meets and exceeds the material requirements of sports soles. It can be seen that the product integrated with the main frame and structure by using 3D printing technology makes product structure and shape light, avoids waste in production materials, saves the time spending in manufacturing and processing and reduces the product cost.

Moreover on the basis of providing practical functions, the product can combine a variety of design elements to better decorate the product shape and make the product having more aesthetic value. With the continuous development of 3D printing technology, a variety of composite materials and metal materials have emerged endlessly so that the appearance of products shows more combinations of comprehensive materials and more decorative possibilities, which adds aesthetics, artistry, and fun, story and thought to the product design. So 3D printing makes product modeling and decoration more diverse ("Fig. 1" and "Fig. 2").



Fig. 1. 3D printed fabric.



Fig. 2. 3D printed wheel chair.

V. CULTURAL VALUE OF PRODUCT HIGHLIGHTED BY 3D PRINTING

3D printing makes product design available to show multiple functions, highlights the essence of creativity and personalization, and can better meet the cultural and psychological needs of individuals in addition to functions, so that personalized products can meet both actual needs and emotional needs; and the emotional design can maximize people's satisfaction and joy, and even forms beautiful memories. Just as many products are rustic and mundane in the eyes of young people; but in the eyes of some specific people, the products can evoke their deep inner memories. This is the cultural value of personalized products ("Fig. 3" and "Fig. 4").



Fig. 3. 3D printed intangible heritage "Lingnan lion (岭南醒狮)".



Fig. 4. 3D printed platform shoes.

With the globalization of information today, being able to use the Internet to customize designs and services that meet individual needs will also become an inevitable development trend of the times. This form can not only meet the needs of consumers, but also allow consumers to participate in all aspects of conception, design and production. In the end, a unique and personalized customized product is formed. This is the research and development process of personalized product.

VI. PERSONALIZED CUSTOMIZATION PLATFORM BASED ON 3D TECHNOLOGY

A. Advantages of 3D technology-based personalized customization platform

3D printing can quickly and easily realize the conversion from a 3D digital model to a 3D entity, build a bridge between the dream and reality, and become an important design tool, method and means in product design. At the same time, this technology makes it available to change creative products flexibly and rapidly and adjust the appearance elements and structural elements of the product, greatly improves the freedom of design, maximizes the improvement of personalized products to meet the needs of users, and becomes the best choice for small-scale production.

B. Thinking of personalized product customization

First of all, consumers have personalized customization needs which mainly include the needs for function, appearance, size, color, and material of product. At the same time, in order to meet consumer needs, companies need to quickly and accurately understand consumer needs, and design and manufacture products in accordance with user needs. In this process, a communication platform is needed to meet the communication, consumption and transaction needs between parties. Therefore, making use of network customization platform to meet the needs of both consumers and enterprises seems appropriately. By accessing to Internet and mobile terminals, the two parties can communicate the product's appearance, function, structure, material, technology, color, and pattern. The enterprise can display product effect through digital modeling and virtual browsing,

then receive consumers' feedback on the design scheme through the Internet, and optimize the design, and finally get the creative idea transformed into product.

C. 3D printing based personalized customization service platform framework

A personalized service platform based on 3D printing technology can integrate 3D printing equipment manufacturers, sellers, designers, and consumers to jointly build a sharing, exchange and trade platform. And a service process and model of consumption + 3D printing + services + transactions is constructed in the process of integrating 5G cloud services and 3D printing personalized customization service platform. It can not only meet the personalized demand but also involves the entire process from personalized design to personalized customization, 3D

printing, and consumption. The network platform can get the definition of 3D printing technology-based product customization need, the positive and negative product research and development, production and processing, sales and service closely linked together so that the consumers, designers, vendors and other parties are fused to the maximum extent to jointly take part in and experience the research and development and customization of product by 3D printing technology. 3D printing personalized customization service is a platform that orients to personalized products, cultural and creative products, innovative education of design, etc., meets the needs of online release of personalized products, design resource sharing, personalized customization and services, online printing manufacturing, 3D printing product development and sales. ("Fig. 5")

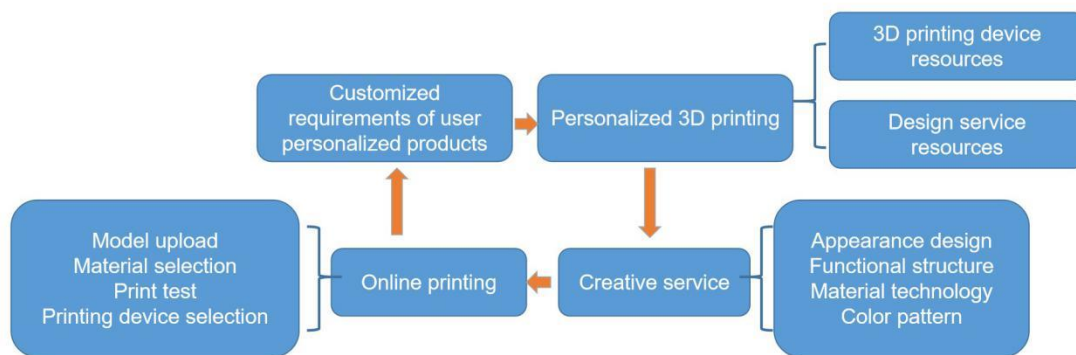


Fig. 5. 3D printing based personalized customization service platform framework.

VII. CONCLUSION

Through 3D printing technology, the mass production of industrial products is gradually changed into single production and personalized customization of product samples. Compared with traditional manufacturing process, this way shortens the cycle of product research and development. The interconnection between 5G cloud services and 3D printing personalized custom service platform integrates the upstream and downstream industrial chains of 3D printing. For example, 3D printing software and hardware manufacturers and service providers can achieve direct links with customers through the network platform, and create more widely adaptable efficiency-first intelligent manufacturing platforms realizing intensive use of resources, to promote industrial development. This is of great significance to the cultural conception dissemination of outstanding products and promoting economic growth.

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