The role of new industrial design training model in the transformation and upgrading of manufacturing industry

Bo Meng Zhe\textsuperscript{1}, ZhangMeng \textsuperscript{1}, Li Wei\textsuperscript{*}

\textsuperscript{1} School of Mechanical and Automotive, Southwest Forestry University, Kunming, Yunnan, 650224, China

\textsuperscript{*}Corresponding author’s E-mail: 250974443@qq.com

Abstract. This paper studies how the new training mode of mechanical industry design promotes the transformation and upgrading of China's manufacturing industry. Through the analysis of the status quo of China's manufacturing industry design, the degree of industrial design engineering is adjusted to the mechanical category policy, and then from the perspective of the new model background, the industrial design complements the mechanical professional ability, the mechanical perfection of the industrial design professional ability, the complementary relationship between industrial design and mechanical skills, and analyzes the new model by improving the design ability of the new composite talents - improve market thinking, improve innovation capabilities, enrich professional skills, master technical theory, and enhance logical thinking to promote iterative upgrading of manufacturing products, thereby promoting the transformation and upgrading of China's manufacturing industry.

1. Introduction

Industrial design is an innovative cross-disciplinary subject, and it is also the primary process in the manufacturing industry. It provides an effective solution to meet the needs of consumers and to solve problems in industrial mass production. Industrial design is a sign of the level of scientific and technological development of a country and a region. Without advanced technology and methods, it is impossible to have a good and high-level design, and even develop new products [1].

China's manufacturing industry is big but not strong, and many problems are outstanding. At present, most of China's manufacturing industry is still only at the level of processing and production. The level of technology in manufacturing is low, lack of core technology and innovation, and product homogeneity is serious [2]. Nowadays, it is still in the catch-up phase of the strategy of “tracking, catching up, paralleling, and leading”. In recent years, in order to speed up the pace of catching up, China has also proposed the development of manufacturing strategies such as “Made in China 2025” and “Building an Innovative Country”. Today's design innovation has been listed as an important direction of the national innovation strategy. Under the background of the big environment and China's supply-side structural reform, the industrial design and the another core technical specialty of the manufacturing industry, the mechanical specialty, will coordinate and promote the product iterative upgrade and technology update to realize the transformation and upgrading of China's manufacturing industry. It is of great significance to improve the international competitiveness of China's manufacturing products.
2. Manufacturing industry design transformation and expansion of new models

2.1. Defects in product innovation and technology place higher demands on designers

The development of industrial design in China originated from the late 1970s. The industrial design in the early stage mainly relied on the introduction and imitation of foreign technology [3], and the design objects were mainly concentrated on small daily necessities. With the advancement of science and technology and the development of society, the scope and characteristics of industrial design have changed with the beginning of the establishment of China. Its scope extends to the design, interaction design and material selection design of large-scale products such as automobiles. The professional knowledge and skills that future industrial designers must possess are increasingly complex, professional and multi-directional.

However, in the international market, “Made in China” is still regarded as synonymous with “Chinese rough” and “Chinese counterfeiting” [4]. In recent years, in order to reduce the cost of design innovation, some manufacturers have exported many non-technical cores and even suspected high-imitation products to domestic and even international markets. The innovation of some products is the separation and reorganization of the color and function of the prototype products, and some products are used by designers to copy the original products by methods such as reverse engineering and reverse design. Finally, the low-quality "made in china" swept the world. It has lowered the competitiveness of China's manufacturing industry in the international market and limited the level of technology and design of China's manufacturing industry. The essence of design is that innovation is not plagiarism. Simple plagiarism cannot be copied to the essence. For example, plagiarism of foreign famous cars can only be copied to the style. There is no way to master the professional design point such as the optimum angle and position of the brake clutch throttle plate, the optimum curve curvature of the seat, and the optimal angle of inclination of the A-pillar. To change the status quo of domestic manufacturing, we must give product technology, charm and core, and fully coordinate the development of the two major manufacturing design professions - industrial design and mechanical design.

2.2. Professional Reform Cultivates New Compound Talents for the Development of Manufacturing Industry

Promoting the formation of the science and technology innovation industry group requires “knowledge-based universities, industries and governments to “overlap” and interact to promote the spiral of innovation” [5]. In terms of education and training, the education and industrial needs of engineering industrial design in some colleges and universities are not equal. The learning is not related to the practical application of product design innovation. Relevant technical disciplines do not pay attention to cross-learning. What they do is generally to improve the modeling problem, attach importance to innovative design, and despise technological innovation; In the design method, the design and technology are still stuck to the traditional sketch deduction. When a series of technical and theoretical contradictions arise, the ambiguity and instability between the problem and the solution cannot be avoided. In September 2018, the Academic Degrees Committee of the State Council of China issued the "Notice on the Corresponding Adjustment of the Authorized Points for Master's and Doctoral Degrees in Existing Engineering" - the degree of industrial design engineering is adjusted to mechanical. The policy officially opened up new models of industrial design and mechanical technology, ensuring complementary integration of mechanical and industrial design disciplines. The product design innovation of rational thinking and logical thinking is reasonably applied in the design process of two professional compound talents. The policy also responded to the slogan "Created by China to Transform by China and Enhance China's Quality” and implemented the "Made in China 2025” policy.
3. Adding and expanding mechanical design capabilities from the perspective of industrial design in the new model

When designing industrial products, most manufacturing companies separate the mechanical design and industrial design parts in the form of departments, resulting in less communication between the internal and external parts of the required design products, and there is a problem that the product form does not correspond to the function, and the product iteration upgrade is too slow. The author believes that after the training of new models based on mechanical industrial design, future designers of mechanical and industrial design professionals can solve problems in product design based on professional perspectives in the design process, reducing ideological conflicts. The design thinking, technical innovation and professional skills of mechanical designers can break through the original limitations of the profession.

- In the design thinking: the formation of the market, customer needs in the primary design thinking.

  In the past, mechanical designers have often neglected the customer demand, market status and other factors in order to achieve the optimal function, structure, strength and other design points of the product, resulting in the result that the developed product does not meet the market demand. However, existing algorithms such as basic theoretical calculations, chip calculations, and artificial intelligence calculations are difficult to present the true demands of consumers. Under the new training mode, mechanical engineers can adjust the design, including the shape and structure, according to the user's needs and product functions at any time to improve the original defects and deficiencies. Thereby improving the ease of use, user-friendliness and user experience of the designed products, and achieving iterative upgrade of the product under the premise of reducing rework modification.

- In technological innovation: enrich innovative thinking and promote technological progress in line with innovation needs.

  From the perspective of mechanical design, the innovative ideas of mechanical designers are often limited by the logic of their professional knowledge requirements and the rigor of the nature of the disciplines. Most of the designs tend to be old-fashioned and lack of creativity. It makes the domestic manufacturing industry progress slowly in innovation and iterative upgrading. The demand of the market makes innovation more traceable, and the technology is realized by innovative thinking. For example, the designer invented the rotatable screen to meet the needs of consumer mobile phone selfie; In order to meet the needs of consumers who want to answer calls more easily during sports, wireless Bluetooth headsets, etc. were invented. Therefore, innovative thinking needs to exceed the speed of technological development in order to promote the development of technology more quickly. On the international platform, breakthroughs in prototypes and innovation are key means for designing big countries to solve the problem of innovative design of manufacturing products. Therefore, the innovative thinking of industrial design and mechanical design can improve the level of innovative design, speed up the development of technology, and promote product iterative upgrade.

- In terms of professional skills: industrial design innovation theory and technology enrich the theory of mechanical design.

  The traditional manufacturing industry has a single mode of production that restricts the mode and means of mechanical design. The manufacturing cycle of the manufacturing industry is longer, which also increases the risk of corporate investment. Design methods such as computer-aided design (CAID/CAM) and computer-aided engineering (CAE) in modern industrial design theory have played an important role in shortening the product development and design cycle, and it can promote new material technology in the selection of product materials; Reverse engineering design mode and concurrent engineering design mode can greatly improve design efficiency; 3D printing technology can design samples at low cost, improve the microstructure of the prototype several times before the production of physical prototype, greatly reduce the cost of design innovation; industrial design skills, such as ergonomics, green design, bionic design, optimized design, also provides more innovative thinking and theoretical basis for mechanical design.
4. The enrichment and extension of industrial design capabilities from the perspective of mechanical design in the new model

Joseph Binbit, the father of innovation theory, once said that “innovation is the fundamental source of enterprises to achieve uncertain growth.” It is difficult to consider the deep content of product quality, function and structure only by divergent thinking innovation, and also make designers unable to grasp the whole process of life cycle such as product manufacturing and market circulation. In the past, the development of industrial design products relied mainly on market demand, ergonomic requirements, and practical and innovative professional perspectives to design products. The design process was mostly filled with research and free and divergent thinking; Product design research focuses on design styling, color and human-computer interaction, focusing on testing the user's visual and interactive experience with the product[6]; The product development process generally takes the prototype as the core, and the trial and error design cycle does not achieve satisfactory results in terms of development efficiency and cost saving. In the mode of industrial design engineering transferred to the mechanical category, the author believes that it can make up for the shortcomings of industrial design from the perspective of mechanical professional manufacturing technology and logical thinking.

- From the perspective of manufacturing technology: adding theoretical support for innovation and improving the technical and feasibility of the design.

In the new mode of teaching and training, the mechanical design theory course provides technical theoretical support for industrial design, which can effectively improve the future product design level, efficiency and reliability of industrial designers. In the product design process, the number of prototypes can be reduced to avoid falling into the repeated trial and error design cycle. Reduced design cycle while reducing costs. The mechanical calculation technology and other technologies also provide inspection reports for product materials, structures and shapes for industrial design, which not only facilitates the optimization of design schemes, but also ensures the feasibility of product design. In terms of material selection, a set of material optimization methods can be established. By using software such as CES Edupack, better materials are selected; Further introducing a compensation function that combines the goals of low cost and small quality, and provides designers with the most material-standard criteria [7]. The emergence of new materials and new technologies has also provided more possibilities for design. The free combination of various materials has expanded the design ideas [8], and promoted the development of manufacturing industry on the basis of promoting product iterative upgrade.

- From the perspective of logical thinking: make the innovative design logical, and ensure the feasibility of product design.

The thinking logic of industrial designers is nourished by the knowledge of mechanical theory. Every step and design point in the design process will be optimized by logical thinking in advance. A logical technical design process speeds up product design and development and productization, and promotes product performance and other features. Toyota Motor Corporation will avoid 80% design defects before trial production, and try to achieve the highest level of optimization design. If the domestic manufacturing industry compensates most of the design defects in the product design process and before the prototype production, it is strictly improved by logical thinking to avoid the judgment errors caused by the traditional design methods. Then we can save a lot of money, reduce waste of resources and improve manufacturing levels.

5. Industrial design and mechanical integration promote a new chapter in manufacturing

Internationally, the composite development of mechanical industry design has long been prevalent, such as the iPhone's original 4-inch mobile phone design: From an ergonomic point of view, since most users use a single handheld device, the thumb swipes the fan screen in the shape of a fan, which is about 4 inches in diameter, so 4 inches is the optimal size for a mobile phone screen design; button design takes into account the material knowledge of mechanical theory, the middle button uses metal buttons, compared to metal buttons in long-term friction Plastic buttons feel firmer, smoother and
more aesthetically pleasing. It can be seen that the design work of the composite industrial design can promote the iterative upgrade of the product.

Traditional industrial design pays attention to styling and despise technology. Mechanical design pays attention to function and ignoring creativity. Under the new mode of mechanical industrial design, designers will break through the original innovative thinking and complement each other in the process of product design and innovation, avoiding the stalemate between two different professional thinking. At the same time, innovative thinking and design theory and method work together to expand the design channels and improve the design level, which in turn promotes technological innovation. The reasonable and effective connection between product design and mechanical design can promote the design and practice of industrial design and mechanical design professionals to realize the harmonious integration of function and shape in design practice[9]. Creating design methods based on technical theory and logical reasoning will invisibly increase product innovation, accuracy and technology. In addition, it is also possible to integrate new technologies, develop new processes, and innovate materials according to the characteristics of enterprise development, demand, characteristics, etc., which is of great significance for enhancing product design quality, improving product technology, and thus promoting the development of national manufacturing. Accelerate the construction of a country with high quality and significantly enhance the quality advantage of China's real economy. It must not only complement the industry's “short board” in product quality supervision, but also comprehensively improve the technical content and technological innovation of export products, and further expand the manufacturing industry [10].

6. In conclusion
Today, with the rapid development of science and technology, in order to accelerate the development of China's manufacturing industry, universities and enterprises need to improve the design innovation model, concept and ability of design talents. The new mode of training in the direction of mechanical industry design is a major opportunity and challenge for traditional manufacturing. Under the new professional direction, the industrial design and mechanical design fields will be deeply integrated in the manufacturing industry, and the innovative thinking and design methods of new composite design talents will be developed to cultivate new full-link designers from the inside to the outside. At the same time, it can form a situation in which the theory promotes technological development and technological perfection of theoretical content, which is of great significance to the transformation and upgrading of China's manufacturing industry and the realization of developed countries in cornering overtaking manufacturing.

Acknowledgments
First of all, I would like to thank the organizers for providing an academic exchange platform for industrial design industry enthusiasts, which has created a good opportunity for the development of domestic industrial design. Secondly, I would like to thank Zhang Meng and Li Wei for their help in the completion of the project. The project was funded by the project “Leading Brands in the Eight Key Industries of Yunnan Province (51600630)”. I would like to express my sincere gratitude and wish the meeting a complete success.

References
[1] Zhang, J.X., Shang, Y.N., Duan, J.J. (2008) Introduction to Industrial Design. China Ocean Press, Beijing.
[2] Liu, Y.H., Liu, Q. (2018) The Effect of Industrial Design on the Transformation and Upgrade of Manufacturing Industry from the Perspective of Industry 4.0. Packaging Engineering, 39: 113-116.
[3] Jin, Y.Z. (2013) On Industrial Design and Innovation under the New Situation. Henan Technology, 3: 35.
[4] Liu, L.Y. (2016) Abandoning and Reflection: Chinese Industrial Design in the Post-Chinese Manufacturing Age. Design, 9: 86-87.

[5] Henry, E. (2016) Three-helix innovation model. Qinghua University Press, Beijing.

[6] Tang, B.B., Guo, G., Xia, J.J. (2017) Research on the Measurement Method of Industrial Design Material Based on User Visual/Touch Experience. Journal Of Mechanical Engineering, 53: 162-173.

[7] Li, Y., Xue, Q., Li, M.Z. (2018) Design of new energy generation vehicle for the elderly facing lightweight target. Mechanical design, 35: 112-115.

[8] Yu, S.L., Mao, Y.M. (2016) The systematic influence of 3D printing technology on industrial design in the 4.0 era. Design, 19: 64-65.

[9] Liu, L.F. (2018) Reform and Exploration of the Course Teaching of "Basic Machinery Design" in Industrial Design Specialty. Mechanical design, 35: 413-414.

[10] Peng, S.T., Li, P.F. (2018) Quality Evaluation and Improvement Path of Chinese Manufacturing Industry Development. Research on socialism with Chinese characteristics, 5: 34-40.