Research Article

Industrial Design of Cultivation Architecture for Innovative Talents in Higher Education*

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Abstract

This paper aims to provide a reasonable architecture for higher education of innovative talents in China's industrial design field. In the future development of manufacturing industry, there is a demand for advanced industrial design innovation talents that depends on the culture and outputs of higher education institution. This paper adopts the qualitative study of literature combing, in phase with the future development trend of China's economy and society, analyzes the current situation and challenges we face in the industrial design talent cultivation mechanism. On the grounds, a cultivation architecture is proposed with the empathic care of humanistic value as orientation, trans-boundary knowledge system as basis, moulding creative thinking, focusing on the teamwork and building the leadership for students. This talent development framework will help upgrade the industrial design level of China's manufacturing industry and other relevant fields.

Keywords

Industrial Design • Innovative Talent Training • Higher Education

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The strength of the manufacturing industry underlies the country's economic and social prosperity. Today, the Sino-US trade friction has a tendency to escalate, but in essence, this strained relation will curb China to transform or upgrade the manufacturing industry. "It's not just a national treasure that matters the booming of the manufacturing industry, but even the national independence". [1]As a country, if it loses its own manufacturing industry, there is no medium to achieve the innovation. Then it will disable to innovate anything. "Manufacturing industry is the first source of technological innovation in modern Western society. It has always been the core domain for realizing the independent invention and technological improvement." In the future, driven by the artificial intelligence and the Industry 4.0, the manufacturing industry will usher in an upswing era of intelligent manufacturing (Smil, 2014). In 2013, the German government proposed the *Securing the Future of German Manufacturing Industry: Recommendations for Implementing the Strategic Initiative Industry 4.0*, in order to seek new transformation and upgrading for German manufacturing industry, ensure Germany's competitiveness in the world and the leading position in the industrial technology domain. They include the intelligent manufacturing project into the German National Development Strategy. The advent of a new era will inevitably mobilize the upgrading of the whole manufacturing industry in the future, which will produce an enormous impact on many fields, including the existing workforce system, social technology factory system, innovation and entrepreneurship education system, human economy and social life.

China has issued the *Made in China 2025* (2015) and the *Development Plan of New Generation Artificial Intelligence* (2017), and proposed the strategic goal for building a future manufacturing powerhouse. By far, China ranks as a world industrial power, but this builds on the world factories and demographic dividends, and dominates low-end labour-intensive industries with products in the low value-added part of the global industrial chain. In the new era, there are unprecedented opportunities and challenges for China manufacturing industry. Industrial designers get familiarity with market demand, and good at applying high technologies to improve service design and cultural brand in traditional manufacturing industry. The development of traditional manufacturing industry requires the industrial designer to help product upgrading, achieve model innovation by designing product system and services, enhance product quality, brand value and technological process, and realize the transition from scale expansion and speed expediting to technological innovation, quality control and brand leadership; from product manufacture to outputs of innovation, system and service designs. It should give play to the leading role of industrial design in the value chain, use design innovation to solve environmental, energy and technological issues, create a "Made in China" brand with national value, and remoulding the new advantages of China's manufacturing industry against international competition. As the major base for cultivating the industrial design innovation talents, higher education institutions should constantly explore high-level talent cultivation model applicable to China's national conditions, and provide a unremitting human resource for the development of China's intelligent manufacturing industry in the future.

Current situation of innovative talents cultivation in industrial design field in higher education

Cultivation localization for industrial design innovation talents

In 2016, the World Design Organization redefines the industrial design, greatly expanding the outer boundaries of traditional definition: industrial design is a strategic process for addressing problems, driven by

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innovating products, systems, services and experiences, it aims to build business success and lead a better quality of life, setting up a bridge between the reality and the infinite possibilities. This is an interdisciplinary area that uses creative ideas to jointly settle problems and propose solutions to build better products, systems, services, experiences and businesses. Its core is to regard the issue as an opportunity, thus more optimistically to look upon the future. It associates innovation, technology, study, business and customers with each other to deliver a new value and competitive advantage through economy, society and environmental spheres (Hamilton, 1791).

Design should be an element that can meet the needs of human beings. As the driving force for social development, it can work through the social and environmental issues that may appear recurrently, so that it not just the accumulation of things. Industrial design is a discipline that aims to improve people's quality of life. China's industrial design can't stay away the studies of China's current society formation, Chinese people's lifestyle, the Chinese product development history, the basic theory of industrial design, and even the China market (He, 2003). As Liu (2005) said, the innovation talents in industrial design field imagine with scientific thinking modes in combination with the recognitive competence in practice, to upgrade the design from creating things to looking for ways. by adjusting the structural system of knowledge and resources. Design is made as a target system that truly adapts to different people and caters to different needs under different external factors (Jaspers, 1991). In short, the industrial design talents cultivated in higher education in the future is not just the product makers who only understand engineering technology and design appearance, but should be service providers who have an insight into the social development and loyally serve for the people. This is only the training goal for future innovative talents.

Problems in the cultivation of innovative talents in industrial design in higher education

From the current situation of China's industrial design in higher education, the education renewal lags far behind the national economic development. The traditional talent cultivation orientation and quality evaluation standards have fallen short of the contemporary requirements for comprehensive quality of talents. In this context, it is even more difficult to achieve the anticipated demand for composite innovation talents who not only know the technology but also are skilled at management in the industrial design field in the future society. The quality evaluation system for nurturing students has not yet been perfect. If employment rate is regarded as the most important assessment evidence for the quality of personnel training, it will inevitably spoil the education business itself; however, as educators, we should also consider how to churn out the talents required in society. This is the dilemma the contemporary higher education institutions face now.

For the moment, industrial design education mainly focuses on the study of Western design, lacks heritage and development of traditional indigenous design culture and the guidance to humanistic value; more involves the instillation of knowledge about skills, less the cultivation of students' sense of social responsibility. Teacher knowledge can not be updated timely and effectively, and international perspective is more limited. The disciplinary structure is independent of cross-border integration. One of gaps of industrial design education in current time is to despise innovative thinking and the development methods.

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What qualities and competences do the industrial design innovation talents have in the future society? In view of the challenges in the cultivation of industrial design innovation talents in higher education, what methods can be used to respond to them more effectively? In this paper, the innovative talent cultivation architecture proposed will provide the clues for higher education institutions to culture the industrial design talents.

Architecture design of innovative talent cultivation in industrial design in higher education

To adapt to the development trend of the times and the current education situation for innovative talents in industrial design in higher education, this paper designs a framework with the concern of humanistic value as objective, the trans-boundary knowledge system as basis, by means of design thinking mode, in order to remould team spirit and leadership of students.

Empathic care of humanistic value as orientation

Industrial civilization has been criticized and misled since its birth. Industrial design was also considered to be an accomplice to environmental pollution, commercial immersion, and the widening gap between poor and rich. But in fact, industrial design not only accelerates the rapid development of human civilization, but also provides living supplies that low-income groups depend on for their livelihood, thus improving the overall material development level of society. With the development of the civilization process, the industrial design in the future needs to integrate humanity and materialization. "Empathic care of humanistic value" is the spiritual navigation for the survival and proliferation of civilization in the human society. If education lacks the correct humanistic value orientation, what it creates is often not the innovative talents the society requires, but the refined egoists. All products of civilization in human society should be concerned with people. Education should explore the spiritual value that deeply implant in the core of design activities, and establish humanistic value standards based on the basic values in the human society. Every educator contemplates where the education accesses, what is the ultimate goal of education, and what kind of people we need to educate. The responsibility for education is not just to impart knowledge and skills, but more importantly, it will culture people with independent judgment, social responsibility, independent thinking, and humanization. As the German educator Carl Jaspers said, "Education is the person's soul education, but not the backlog of rational knowledge." It is especially important for industrial design educators, who hold the responsibility for guiding students to use thinking of humanistic values clean up the trouble cases and problems caused by human beings instead of producing more industrial waste (Lu, 2012).

Trans-boundary knowledge system

The industrial design service field is rapidly extending, and the integration between new materials and design technologies has been broken through constantly, while further integration between information and manufacturing technologies undermines original knowledge structure of industrial design repeatedly, which

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raises a new challenge for the cultivation of innovative talents in industrial design education, that is, there is "a demand not only for multidisciplinary (such as computer science, engineering science, psychology, physiology, management science, marketing, etc.) integration, but also for deep interaction among knowledge, technology, humanities and art science to enhance intelligence, humanized and artistic level of experience." Those graduates in traditional industrial design major tend to be good at a certain design field, but the contemporary industrial design has been greatly extended to many fields such as computer science and technology, art layout, software engineering, industries, network engineering, information security, Internet of Things, multimedia digital art, intelligent science and technology, spatial information and digital technology, electronics and computer engineering, etc. It is required to achieve the development of the full process from single to integrated designs, from creative ideas to solution to problems (Brown, 2015).

The establishment of a trans-boundary knowledge system is to use transboundary perspectives and ideas to deal with new topics, rise to new challenges, and address new problems. This is not only the leap of design skills, the dissolution of the boundaries of design categories, but also the breaking of discipline barriers and the transformation of design concepts. The design curriculum of top universities at home and abroad have launched the teaching model of cross-border cooperation. In America, the National Association of Schools of Art and Design (NASAD) has also developed a special curriculum standard for Creative Multidisciplinary Convergence and Technologies (CMCT) in American design colleges. The Media Lab at the Massachusetts Institute of Technology strives to explore cross-border integration with different areas such as media, design, art, and science to settle social problems. The School of Visual Arts in New York has pioneered the "Social Innovation Design" program, focusing on social issues such as environmental protection, social welfare, food hygiene, poverty alleviation and women's rights and interests, justice and fair trade, education and social revitalization, etc. With conceptual design, organizational models, communication and information design, a concept can be reflected such that the design serves the society. The Academy of Arts & Design, Tsinghua University, conducts cross-cooperative instruction on innovative design and engineering, technology, and business, and explores a talent training model with multidisciplinary foundation and national vision. The advent of Industry 4.0 and the era of intelligence has made the cooperation of digital, intelligent and cross-border design necessary. Higher education more needs to dissolve the boundaries inside and outside the disciplines, to create a multi-disciplinary cross-border knowledge system for students. Only in this way can we better cope with complex and comprehensive issues occurred in the future.

Development of design thinking mode

While the industrial revolution contributes business prosperity and affluent life to human beings, it has also created a world of crisis. The mass production of cheap goods causes huge waste, pollution and environmental issues. There is a need for a revolutionary and innovative approach to integrate business and society in order to tackle these issues. Nobel laureate Herbert A. Simon wrote in his book *Artificial Science* that design can be used as a way of thinking. The concept of design thinking was formally proposed by the famous design company IDEO in the world. This is a human-centered design method, that is, a rule that uses the designer's perception

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and thinking modes to meet human needs that are technically, commercially and socially feasible and can be converted into market value and business opportunities.[3]

Design thinking mode has been regarded as an important concept and method for understanding the world and addressing problems in the world. It has been widely used in engineering, management, design and other areas, and has been highly valued in the education circles. Some universities also use the design thinking mode as an important means for developing students' imagination and creativity, such as the "D-school" college at Stanford University, the "Laboratory for Research Techniques" at the Art Institute of Chicago, and the "Study of Design Contexts" of the American Institute of Creative Studies, the course of the International Design Innovation Institute" of the School of Design and Innovation, Tongji University, etc. The basic process of design thinking mode includes: Empathize, Define, Ideate, Prototype, and Test. It is more important to develop design thinking in industrial design education than skill training. These kinds of capabilities such as problem finding, rational judgment and proper handling in the face of complex problems, and the stimulation of creativity to solve problems in various ways are what the design innovation talents are required in the future.

Modelling teamwork and leadership

Unlike artists, designers need to use the different forms of languages as tools and hold teamwork spirit. Traditional industrial design mainly focuses on the relationship between people and things, but with the rapid development and application of artificial intelligence, Big Data, Internet of Things and other technologies, the industrial design service model transforms from product design to service design, that is to say, it changes to offer problem solving ideas or service programs, etc., achieving the transition just like from "fish" to "fishing". The industrial design service model has been continuously upgraded, and the organizational structure has also undergone changes. Industrial design has penetrated into the level of the relationship between people and people, and between things. The leadership has become an important support power throughout the process since it can guide design directions, activities and project implementation, and ensures that design results are aligned with corporate strategy and social development targets. In the past, the carrier responsible for design tasks was mainly composed of subsidiaries under enterprises and design companies. With the big data and the Internet, in the future, there is a trend to develop the design platform that radiates to multi-point demands. Design has become such a profession that requires more and more collaborations between organizations, divisions, and different members.

Design leadership implies the sense of social responsibility, strategic height and vision, creativity, insight, leadership skills, communication, organization, management, execution power, influence, etc. based on a high level of professional knowledge attainment. Talents with design leadership are familiar with design principles and methods, effectively communicate the company's development vision and ensure the smooth implementation of the company's strategic process. In the currently advanced university education, for example, the University of California at Berkeley, Harvard University, MIT, and Stanford University, there are agencies that set up a special training on students' design leadership, emphasizing students' active involvement in social activities, allow professors and students to co-organize topics to cultivate students' team spirit and leadership

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skills, and establish an intellectual connection between leadership and creativity. China's higher education should incorporate leadership training into the cultivation content of industrial design innovation talents.

Conclusion

Industrial design talents urgently required by manufacturing firms in the future need to have a high sense of social responsibility, lay a sound foundation in trans-boundary knowledge systems such as computers, information technology, art, and engineering, make good use of creative thinking modes and have design leadership that leads the future product development. On this background, China's higher education should make reasonable localization and adjustment in line with the national development strategy, industrial upgrading and the demand for innovative talents in due time, develop their own educational philosophy and styles, and in response to the domestic manufacturing transformation and upgrading and the competition pattern in global industries, to churn out a steady flow of innovative talents in the industrial design field for the domestic manufacturing industry. The industrial design innovation talent cultivation architecture proposed in this paper is expected for providing the clues to the culture of higher education talents in domestic industrial design field in the new era.

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