NEW TRENDS OF ERGONOMICS AND ITS IMPORTANCE IN MODERN INDUSTRIAL DESIGN

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Abstract: Today's industrial design has gone beyond the traditional product design. China is in the transfer process from the world's manufacturing plant to the world's manufacturing center. Chinese manufacturing industry is transiting from mass production and mass marketing to brand competition and design competition; China's industrial design is moving from design for products and design for industrial enterprises to design for the market and users, and from basic industries- and technology-oriented model to sales- and marketing-oriented and brand- and user-oriented model. The importance of implementing user-friendly design principles and applying ergonomic principles to sustainable design in industrial design is increasingly becoming the consensus of the industries. And it's vitally important to understand fully the importance of ergonomics to the development of modern industrial design, the characteristics of modern ergonomics and its research targets, and the green design concept as one of the development trends of ergonomics.

1 FULLY UNDERSTAND THE IMPORTANCE OF ERGONOMICS TO THE DEVELOPMENT OF MODERN INDUSTRIAL DESIGN

Today's industrial design has gone beyond the traditional product design. China is in the transfer process from the world's manufacturing plant to the world's manufacturing center. Chinese manufacturing industry is transiting from mass production and mass marketing to brand competition and design competition; China's industrial design is moving from design for products and design for industrial enterprises to design for the market and users, and from basic industries- and technology-oriented model to sales- and marketing-oriented and brand- and user-oriented model. Digitalized life, economic globalization, infrastructure management, climate change, consumer factors will influence the worldwide trends in industrial design.

The situation of industrial enterprises' success by relying solely on technology, human resources and cost has become in the past. People have begun to emphasis more on the design management model which integrates together brand, technology, marketing, strategy and innovativeness, which is the development model of design needed to promote Chinese enterprises to transfer from the world's processing base to the world's manufacturing center. The innovative design as an important strategy for enterprises' innovation development has become the consensus of the academia and the industry.

We see more and more manufacturers take "people oriented", "ergonomic design" as the characteristics of their products to be advertised, especially those products that require direct contact with the body or the direct manual operation are more prominent. In fact, letting the design of the machine equipment and working and living environment suit to people's physiological and psychological characteristics, so one can work and live in a comfortable and convenient conditions, is the issue to be addressed by ergonomics. In other words, ergonomics is such an engineering science arising from solving the problems.

The scope of ergonomics is of very broad range, which is based on the studying of human physiology and psychology. It is to apply directly the practical science, and the technical sciences to the actual operation, and is the origin of the human body engineering. Ergonomics studies human as the most fundamental and direct research and service object,

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so all the information must get from the people and hence the judgments would be made based on the integrated information. Ergonomics is the application of human-related science information to the design of objects, systems and environment, which involves every aspects of human life. Ideal designs should be reflect fully the principles of ergonomics in working system, sports, leisure, health and safety and other aspects.

The characteristic of ergonomics is based on a careful study of their own characteristics of the three elements, i.e. human, machine and environment. It does not simply focus on whether the individual elements are good or not, but studies as a whole the system which includes human that employees the "objects", the "objects" designed by the designer and the coexistence environment of the "objects" and human. The so called system in the ergonomics is referred to as "human - machine - environment" system. In this system, the relationship of interacting and interdependence of the three elements of human, machine and environment determines the performance of overall system. Ergonomics makes scientific use of the organic links between the three elements to seek the best parameters of the system.

A good design must be the product in which the factors of human, environment, technology, economy and culture etc., are cleverly balanced. To this end, it is required that the designers have the ability to find an optimal balance in a variety of constraints. To evaluate and determine the standard of the optimal balance point based on the common goal of both ergonomics and industrial design, the "human-oriented" dominant ideology should be adhere to as the core of design.

The "human-oriented" dominant ideology is represented in every design activity to put “people” as the main line and implement the main line of ergonomic theory throughout the entire design process. And the social development, technological advances, product updates, intense pace of life ..., all these will inevitably lead to the changing view of quality towards "object". People will pay more attention to the evaluation of the weighing of "convenience", "comfortable", "reliable", "value", "security" and "efficiency". The rapid development and wide application of ergonomics and other emerging interdisciplinary will surely push the standard of industrial design to the new heights sought by people.

With full development of mechanization, automation, and information technology, the influence of human factors in product design and production is increasing; the issue of harmonious development of man-machine will be more and more important; the status and role of ergonomics in industrial design will show more increasingly its importance.

2 FULLY UNDERSTAND THE CHARACTERISTICS OF MODERN ERGONOMICS AND ITS RESEARCH TARGETS

Modern ergonomics began its development stage from the beginning of 1960s. During this period, Europe and the United States entered into the large-scale economic development period. At the same time, ergonomics have undergone more opportunities of advancement because of scientific and technological progress. As the research and application fields in which ergonomics involves are expanding, the number of professions and disciplines in which the ergonomics experts undertake their research are also increasing, which include anatomy, physiology, psychology, industrial hygiene science, industrial and engineering design, work study, construction and lighting engineering, management engineering and other professional fields. International Ergonomics Association (IEA) accounts that the engineering development of modern ergonomics has the following three characteristics:

1) Different from the traditional ergonomics which had its studies focused on the selecting and training a specific person to adapt the work requirements, modern ergonomics focuses on the design of the mechanical equipment, so that the operation of machine does not exceed beyond the limits of human ability.

2) Combine closely with the practical application. The specific machinery and equipment are designed through a wide range of carefully planned experimental research and by utilizing as much as possible the known basic principles.

3) Strive to make the experts and the scientific research staff in various related engineering and science areas work together closely, such as the experts in experimental psychology, physiology, functional anatomy and other disciplines, and the research staff in physics, mathematics, engineering etc.

For industrial designers, the main research areas of ergonomics can be summarized as follows:

2.1 Human Characteristics

The main object of research is human-related issues in industrial design, for example, the characteristic facts of human body shape, transmission of human perception, human response characteristics, and the psychological characteristics during working. The goal of study is solving how the design of mechanical equipment, tools, and a variety of workplaces and other facilities and articles can adapt human physiological and psychological characteristics such that it would be possible to create a safe, comfortable, healthy and efficient working conditions for the users.

2.2 Overall Design of Man-machine System

The performance of man-machine system depends primarily on the overall design. That is, to adapt the "machine" with the human body as a whole. What the basic reasons of successfully coordination of human and machine? The answer is: either man or machine has their own characteristics, and the deficiencies of both man and machine in the system can be complemented by each other. “Machine” has big power, fast speed, and no fatigue, etc., but “human” has the wisdom, multiple skills and a very strong adaptability. If you can do your best to make up for each other's deficiencies, then the combination of man and machine will be effective. Obviously, the basic design problem of the system to be disposed is the division of work between human and machine and the effective exchange of information between the two.

2.3 Design of Workplace and Information Transmission Devices

Whether workplace design is reasonable will have a direct impact on human’s productivity. Workplace design generally including: work space design, seating design, operating table or console design and the overall arrangement of the workplace. All these designs require the application of knowledge and data from anthropometry and biomechanics. The purpose of workplace design studies is to ensure that the physical environment could suit for the characteristics of the human body and the human body could work in a healthier position and posture, so that not only to complete the work efficiently, but also to feel comfortable and not to fatigue too early.

2.4 Design of Environmental Control and Safety Protection

Broadly speaking, efficiency studied in ergonomics, not only refers to the work undertaken to be completed in the short period, but is not present harmful health effects in the long term work and to reduce the risk of accidents to a minimum limits. In terms of the environmental control requirement, it should ensure that the common operating environment such as lighting, microclimate, noise and vibration conditions suit to the operator’s demands.

It is the basic task of the designers to protect the operator from the "pain, illness, injury, or casualty” caused by work. Thus in the design phase, safety guards devices are designed as parts of the machine and the protective devices should directly link into the machine. In addition, the operator's safety training before using the machines should be considered and the individual protection for the operator during the use needs to be researched.

3 FULLY UNDERSTAND THE GREEN DESIGN CONCEPT AS ONE OF THE DEVELOPMENT TRENDS OF ERGONOMICS

Green Design (GD), is also known as eco-design, environmental design, life cycle design, or environmental awareness design. Although the names are different, but the basic idea is that: the environmental factors and pollution prevention measures should be incorporated into products in the design phase, to take the environmental performance as product design objectives and the starting point; and striving to minimize the impact of products to environment.

What is the so-called green design? That is, under the guidance of ecological philosophy, and using ecological thinking, to incorporate the design of objects into "human, machine, environment" system, which both considers to meet the needs of people, and pays attention to the principles of the ecological environment protection and sustainable development, and not only realizes social values, but also protects the natural environment and promotes the common prosperity of people and the environment. It is consistent with the requirements of sustainable development of human society, in line with the ultimate goal of comprehensive development of mankind.

Green design is the basis of access to green products, and has become one of the hot researches in design areas. The results show that the design phase determines the 70% to 80% of manufacturing cost, while the design itself accounts for only 10% of

the total cost. The importance of the roll of design to product is still increasing if considering the environmental factors. Because the level of ecological damage caused by the product design is far greater than the level of ecological damage caused by the design process itself, only in the design stage should the "green level" of products be taken as a design target, the desired design result could be achieved, which is one of the goal of ergonomics.

Green design and traditional design are very different in the design basis, the designer, design techniques and technologies and the design targets, See Table 1 on green design compared with traditional designs.

In sum, the main features of green design include the following:

1) Slow down the consumption of resource wealth on the planet. With green design, the materials for making components of the product are fully and effectively utilized, and in the product life cycle, the energy consumption is minimized, thus reducing the needs for material and energy resources, so that it can be consumed in a reasonable and sustainable way.

2) Reduce waste generation from the source. It's a basic requirement for green designer to reduce energy consumption in the structure and process of product making and use. There will be no toxin and side effects and the dismantling and recycling of the old used products can be convenient. The recycled materials can be used for reproduction. The products of non-recovery value can be innoxiously disposed so that the atmosphere, water, etc., cannot be polluted and the generated waste can be minimized.

3) Reduce the disposal problem of large amount of waste. Green design will nip the waste generation in the bud, so the amount of waste can be reduced to a minimum, which can greatly ease the pressure of waste disposal. help protect the environment, maintain ecosystem balance and achieve sustainable development.

4) Green design is the design of parallel closed-loop. The life cycle of traditional parallel design is all the stages from design, manufacture up to disposal of the product. All the post stages after the product disposal are not considered. Hence it is an open-loop process. Whereas the life cycle of green design, in addition to the traditional life cycle, also includes the disassembly, recycling, treatment after product disposal, so that the closed-loop cycle of product life cycle can be achieved.

4 CONCLUSIONS

China is in the transfer process from the world's manufacturing plant to the world's manufacturing center. Chinese manufacturing industry is transiting from mass production and mass marketing to brand competition and design competition; China's industrial design is moving from design for products and design for industrial enterprises to design for the market and users, and from basic industries- and technology-oriented model to sales- and marketing-oriented and brand- and user-oriented model. The importance of implementing user-friendly design principles and applying ergonomics principles to sustainable design in industrial design is increasingly becoming the consensus of the industries. So, it's vitally important to understand fully the importance of ergonomics to the development of modern industrial design, the characteristics of modern ergonomics and its research targets, and the green

Table 1: Comparison of green design with traditional design.

Comparison elements	Traditional design	Green design
Design basis	Design based on the product's requirements on function, performance, quality and cost proposed by users	Design based on environmental benefits and ecological indicators plus the requirements of product on features, performance, quality and cost
Designers	With little or no consideration of using effectively renewable resources and the impact on ecological environment	The designer must consider to reduce energy consumption, to recycle resource and to protect the environment in the product concept and design stage
Design technology and process	Product recycling is rarely considered in the stages of making and use. Only a limited recovery of precious metals.	Removable, easy recovery, non-toxic side effects during manufacture and use of product, ensuring minimum waste generation
Design purpose	Demands are considered as the main design purpose	Design based on the needs and environment to meet the requirements of sustainable development
Products	General products	Green products or products with green sign

design concept as one of the development trends of ergonomics.

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