Research on Product Design Technology of Computer Aided Innovation

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Abstract—This article mainly briefly introduces the related content of computer-aided innovation technology. This article discusses the effective application of computer-aided innovation product design technology by analyzing the necessity of knowledge utilization in the process of product innovation design. This article takes full advantage of computer technology, constantly innovates product design, develops products that meet people's actual needs based on market demand, and optimizes product design. This can guarantee the quality of product design and enhance the company's market competitiveness. The effective use of key knowledge can not only solve the technical difficulties in product design innovation, but also improve the technical level of computer-aided innovation product design.

1. INTRODUCTION
In recent years, in order to adapt to the increasingly fierce market competition and the domestic and foreign market environment, enterprises should continuously innovate production technology, improve production technology level, and maximize the production efficiency of enterprises. In this process, companies need to constantly monitor changes in market supply and demand, innovate product designs based on market demand, and strengthen product research and development. This is not a simple task, it involves many aspects. It takes a long period of time from the initial product design concept innovation, product development stage, to the final product development success. This process will encounter various challenges and problems, which requires enterprise product designers to have good product development skills and rich product development experience. This can effectively solve various problems in product design, thereby improving the technical level of product design. Computer-aided innovative product design technology has attracted more and more attention. It has gradually become one of the important technologies in product research and development, which is conducive to the development of new high-quality products.

2. RELATED CONTENT OF COMPUTER-AIDED INNOVATION TECHNOLOGY
The application of computer-aided innovation technology is not only conducive to improving product design efficiency and ensuring the functions of new products, but also conducive to continuously tapping the market application value of new products and meeting market demands. The advantage of computer-aided technology is that it can integrate relevant knowledge and technology in different fields and disciplines, and integrate actual needs to provide reliable knowledge guarantee for product designers. It can make it work out a complete product design plan, reflect the individualization of new products, and improve product design quality. This can avoid the failure of product innovation design
results, avoid wasting manpower, material resources, and funds, and can effectively solve various problems and contradictions in product design. The principle of computer-aided innovation technology can be based on the contradictions existing in product design, using different dimensions of knowledge to resolve their contradictions. For now, there are two main types of computer-aided innovation software. The first is software that solves various problems in product design; the other is software that analyzes and troubleshoots the design system in detail [1].

The computer-aided innovation technology platform mainly includes the following functional modules: Firstly, the problem analysis function involves the project navigation module and the system analysis module. The role of the former is to sort out various problems in the product design process and to coordinate the management of the entire project. This can ensure the smooth execution of each link. The latter requires designers to start from the whole, scientifically analyze every link and component in the product design process, and implement cost value analysis. The second is the problem-solving function, which involves the solution module and innovation away from the module. The former's role is to provide designers with detailed and effective solutions. The latter is to provide inspiration for designers to break through technical difficulties. The third is the program generation function. When designing a product, it is not only necessary to pre-define the plan, but also to formulate alternative plans, and compare each plan to select the best plan. The fourth is knowledge management function. This means that in the actual process of product design, sorting out the new knowledge generated, establishing a special knowledge base, and realizing knowledge resource sharing [2]. The representative CAI software on the market is shown in the Table 1 below.

| Number | Name of Software      | The Main Function                                                                 | Development Company                      |
|--------|-----------------------|----------------------------------------------------------------------------------|------------------------------------------|
| 1      | Ideation WorkBench    | Provide engineers with a comprehensive and systematic approach to solving innovation problems, including 7 modules: innovation problem analysis, problem expression, system operation, innovation case library, innovation navigation, evaluation and network learning modules | Ideation International Inc. (America)    |
| 2      | Goldfire Innovator    | Provide engineers with structured solutions to create problems, including 4 modules: optimized work platform, researcher platform, innovation trend analysis and innovation knowledge base | Invention Machine Corporation(America)   |
| 3      | CREAX Innovator Suite | Help engineers to achieve innovation and resolve conflicts step by step, including 10 modules: interactive quick browsing, problem description, resources and constraints, evolutionary trends, evolutionary potential, innovation principles, conflict matrix, system models, selection tools, and knowledge rate. | CREAX NV (The Kingdom of Belgium)         |
3. **THE NECESSITY OF USING KNOWLEDGE IN THE PROCESS OF PRODUCT INNOVATION AND DESIGN**

Product innovation design is not a simple process, it has to go through four stages. The first stage is to design the product according to market demand; the second stage is the innovative product design concept; the third stage is the innovative product design technology; The fourth stage is the specific product design plan. Each stage is a link that the product design work needs to go through, and it is interlocking and essential. Moreover, every link needs the support and guarantee of computer-aided innovation technology. Innovative product design is becoming more and more complex, and functional requirements are increasing. In this case, it needs to comprehensively consider many factors, take into account every detail, and constantly try to find problems. At the same time, it also needs to adjust the product design plan to ensure the feasibility of the product design plan. The use of computer-aided technology is conducive to obtaining various information related to product design. Putting this information and technology through the entire process of product design can provide a reliable technical basis for product design and enhance the effectiveness of its design innovation schemes. The effective integration of product design concepts and specific design schemes is conducive to optimizing product structure design. Making full use of product design related resources and information can ensure the smooth development of new product design work [3].

In the process of product innovation and design, it is very necessary to utilize knowledge resources. Its necessity is mainly reflected in the following aspects. Firstly, a large amount of relevant technical knowledge should be applied according to product design characteristics when carrying out product innovation design. This can guarantee the feasibility of the product design scheme. This also requires the use of a number of technical research results in different fields and specialties. This involves the integration of cross-domain knowledge, which can reflect the advanced technological level in various scientific fields. The application of computer-aided innovation technology is conducive to the integration of advanced patent technology resources. In-depth research based on these technologies will help make conceptual design possible and enlarge product design advantages. This can not only change the problems and deficiencies in product design, improve the utilization of knowledge resources, but also lay a solid foundation for product design innovation, promote product design efficiency, and ensure the final quality of product design [4]. Secondly, when designing a product, it is not allowed to copy the patented technology, it needs to make corresponding selection and allocation according to the needs of the product design. A large amount of knowledge and technology are needed in product design innovation, and at the same time, many knowledge problems will be encountered. Enterprises can use patented technology flexibly in the design stage, but they must not deviate from
the original intention of product design, lest the application of patented technology will restrict product design. Different areas of knowledge will inevitably have different aspects, and not all product designers are comprehensive professionals. When encountering unfamiliar domain knowledge, they cannot effectively use knowledge resources to carry out corresponding product design work, which will affect the smooth development of product design work. In this case, you should consult professional technical personnel in the same field, give full play to the role of knowledge resources, and formulate appropriate product design plans. In addition, companies can ensure the effective implementation of their value engineering and obtain scientific evaluation of results after determining the design plan. Meanwhile, companies also need to conduct social evaluation of design results to judge the comprehensive benefits they bring.

4. EFFECTIVE APPLICATION OF COMPUTER AIDED INNOVATIVE PRODUCT DESIGN TECHNOLOGY

4.1. Computer-aided Innovation Product Design Technology Process
When enterprises implement computer-aided innovative product design technology, they need to pay attention to systematic management, and handle all aspects of product design from different angles, so that they can be effectively integrated and avoid conflicts of design injuries. For example, when designing products, companies need to have a solid theoretical foundation, combine and apply multiple design methods, and innovate product designs across multiple engineering fields. This can not only give full play to modern computer software technology and natural language processing technology to improve the level of computer-aided innovation technology, but also build a complete computer-aided innovation system to give full play to the functions of computer technology tools. As a product designer, he should discover the initial problems in the design process in time. Subsequently, companies need to conduct a scientific analysis of the causes of this problem, collect various related information, to find effective solutions to problems, improve product design quality, and meet people's actual needs. Companies can list the problems they encounter, verify and solve each problem one by one, and choose an appropriate solution. This can effectively integrate product design knowledge information and improve the utilization of knowledge resources. In the meantime, assessing the feasibility of product design schemes can predict possible risks. Besides, companies need to implement scientific evaluations of product design plans and generate corresponding reports, so as to lay a solid foundation for the smooth development of product design work [5].

4.2. Pay Attention to the Analysis of the Problem
When using computer-aided innovation technology for product design, companies need to pay attention to problem analysis. Once a design problem is found, the company should analyze it from multiple perspectives. Enterprises can check the three major modules in product design one by one. The first is the product design navigation module, the second is the system analysis module, and the third is the problem decomposition module. When formulating the product design navigation module, the company should first sort out the relevant conditions to ensure the feasibility of the product design and grasp the actual situation of the product design. Subsequently, the company should formulate an appropriate product design plan, estimate the problems that may arise in the product design process, and classify scientific problems. In this way, every design step and process can be recorded from an intuitive perspective, and every product design information can be paid attention to [6].

In the process of computer-aided innovation technology system analysis, product designers must fully understand the functionality of the product and accurately position the product role according to the market environment. Simultaneously, product designers must scientifically analyze the product design process, obtain accurate system analysis results, and synthesize relevant design reports to continuously improve product design plans. Enterprises should also grasp the details, discover problems in product design in time, and take effective measures to solve their problems and conflicts to ensure the smooth development of product design. Enterprises should give full play to the role of
computer-aided innovation technology and formulate appropriate design indicators. This can clarify the application value of the product and enhance the functionality of the product.

When companies are decomposing computer-aided product innovation and design, they must not only analyze the surface problems in the product design process, but also in-depth analysis of the source of the problem. Enterprises should use computer technology to independently decompose product design problems, find out the causal relationship among them, give full play to the role of existing resources, and improve the level of product design. Computer-aided innovation technology is conducive to finding the causes of product design problems in time and effectively optimizing them. This can also avoid and prevent the occurrence of design problems to ensure product design quality.

4.3. Use Computer-aided Innovation Technology to Solve Design Problems

Companies can use computer-aided innovation technology to solve problems when designing products. Enterpises can explore from three aspects. Firstly, the solution. This means that when problems arise in product design, companies can use computer-aided innovation technology to find effective solutions. This is because with the support of computer-aided technology, the knowledge base on product design contains content in multiple fields, including but not limited to engineering content, technical structure, image design, etc. Enterprises can choose appropriate solutions based on actual problems in product design, combined with relevant knowledge resources in the knowledge base. This can guarantee the quality of product design and do a good job in product research and development [7].

Secondly, stay away from innovative product design. This means that under the support of computer-aided innovation technology, companies can self-present the contradictions in product design through the guidance of the latest product design principles. Enterprises can effectively solve the contradictions in product design based on existing factors, implement full-process management, and find the best way to resolve contradictions. Different solutions are different in actual operation, and the theoretical basis is different. Companies can use computer animation technology to present the basic principles of different solutions to help product designers strengthen their understanding and ensure the smooth development of product design work. At the same time, companies should encourage product designers to continuously explore their thinking and break through technical problems in product design.

Thirdly, companies can give full play to the role of computer-aided innovation technology platforms when they are carrying out product design problems and solving them. Companies can search for related technologies based on domestic and foreign patent search systems. This is conducive to expanding the patent information collection channels for technicians and bringing inspiration to design technicians. Meanwhile, it can also find functions suitable for product design and obtain technical support.

4.4. Computer-aided Innovative Product Design Solutions

When generating computer-aided innovative product design solutions, companies not only need to scientifically evaluate their solutions to judge whether they are feasible, but also evaluate the risk factors they may bring. When designing a product, the designer will have alternatives in addition to the selected design. It aims to select the best solution based on product functional requirements and product design requirements. The choice of this program requires the support of computer-aided innovation technology. Enterprises can use computer-aided innovation technology to evaluate the various parameters of the product and fully grasp the information about the product. Subsequently, the company should conduct comprehensive analysis and consideration to evaluate whether there are problems in its final design plan, and if there are problems, it must be corrected in time [8].

There are two ways to evaluate the design of computer-aided innovation products. Firstly, subjective evaluation. This mainly refers to the comprehensive opinions of experts in multiple fields to construct a scientific evaluation model through computer technology, and to customize evaluation indicators based on the personal experience and background conditions of different experts. In the meantime, companies need to set the weights of these indicators to get the final subjective evaluation results. Secondly,
objective evaluation. This refers to the use of various parameters and patent citations for comprehensive consideration, and objective evaluation of product design schemes. Enterprises should use computer-aided innovation technology to display the final evaluation results through icons, digital percentages, etc., and compare the evaluation results of different programs for ranking. In this way, not only can a detailed plan design analysis report be generated, but also a scientific reference basis can be provided to product designers to improve the level of product design.

4.5. Value Analysis of Computer Aided Innovative Product Design
When designing products, companies need to carry out efficient value analysis to evaluate the value of the designed products. The enterprise should analyze the application value of the designed product from the perspective of enterprise production and operation needs and market demand. This is conducive to the company's continuous improvement and enrichment of product functions, so that its value can be improved. To ensure the smooth development of value analysis work, enterprises should attach importance to the quality of value engineering. When designing products, companies must not only strengthen scientific research, innovate product design, and improve product design technology, but also need to identify samples and conduct market analysis for new products based on value engineering. Companies can find market demand changes based on understanding the positioning of old products in the market and grasping market demand. Simultaneously, companies need to design products that are more in line with market needs. This can reduce product prices while improving product quality, making it more competitive in the market. Enterprises can analyze the value of new products from the perspectives of production and materials. Otherwise, companies need to examine the functionality of new products; on the other hand, companies need to examine the prices of new products. Enterprises must not only guarantee the quality of new products, but also formulate appropriate prices based on their costs to reflect the value of new products. For example, the current mobile phone products are updated very quickly. When developing new mobile phone products, companies need to consider the functional needs of today's consumers. In the past, people's demand for mobile phones may only lie in communication functions, but now the development of intelligent technology makes mobile phones more and more functional. As a result, when designing mobile phone products, companies need to use computer-aided innovation technology to continuously optimize and enrich mobile phone functions, and to make technological innovations for an important feature such as a camera. Furthermore, there are so many mobile phone brands and types in the market. In order to improve the competitiveness of new mobile phone products, while upgrading the functions of mobile phones, companies also need to control the R&D and production costs of new products and choose higher cost-effective prices. The scientific application of computer-aided innovation technology is conducive to handling the relationship between product design costs and benefits. When companies analyze the value of new products, they also need to consider the service life of the product, and evaluate it from various aspects such as product design and production. Enterprises need to collect data related to product design and accurately estimate the production cost of the product. In this way, a scientific evaluation of product functions can be made. In addition, this can also ensure that computer-aided innovation technology can solve various problems in product design, obtain effective information, and achieve product design goals.

5. Conclusion
All in all, in the product design process, computer-aided innovation technology plays an important role. Enterprises should reasonably apply computer technology to optimize product design plans, improve product design quality, and promote the sustainable development of enterprises.

References
[1] Wu Chengyi. Research and development of computer-aided product innovation design system[J]. Electronic Testing, 2018: 129+134.
[2] Zheng Yunchang. Research on product design technology based on computer-aided innovation [J]. Great Science and Technology, 2019: 247.
[3] Hu Huabo. Research on the Combination of Computer Aided Technology and Mechanical Design and Manufacturing[J]. Internal Combustion Engine and Parts, 2017
[4] Ding Qiong, Cheng Dezhi. Research on the combined application of computer-aided technology and mechanical design and manufacturing[J]. Professional circle, 2017
[5] Han Xingchuan. Research and application of product design technology based on computer-aided innovation [J]. Journal of Chifeng University (Natural Science Edition), 2017
[6] Chen Yifan. Research and application of product design technology based on computer-aided innovation [J]. China Science and Technology Investment, 2018: 275.
[7] Bao Yu. Research on Computer Aided Innovation System Design Based on TRIZ [J]. Electronic Production, 2014: 72.
[8] Zhang Jianhui, Tan Runhua, Zhang Zhengyan, Dai Jinling, Yang Xinlin. Research on the integration of product conceptual design and detailed design driven by computer-aided innovation technology[J]. Chinese Journal of Mechanical Engineering, 2016: 53-63.