

Research on the Thinking Process Model of Technical Innovation in Product Design

Xin Wu, Fengqi Yang^{a, *}

The product design, School of art and design, Huaihua University, 418000 China

^a2075591387@qq.com

*Corresponding author

Keywords: Design thinking, design cognition, thinking model, technological innovation, product design

Abstract: In order to enable researchers to fully stimulate thinking and promote the technological innovation spirit and thinking of researchers, the paper will have the opportunity to analyse and explore the computer model of the "divergence-convergence" oriented thinking process from the perspective of researchers' cognitive thinking, Based on the principle of thinking to promote design and its implementation method, a technological innovation thinking model of thinking to promote model design is established. The paper adopts cognitive thinking model and rrinkophapy data analysis method to verify the validity of the application of computer model. This paper uses the thinking process computer model to build a platform for researchers to assist the thinking process to promote the computer model, which can have a guiding role in the researcher's technological innovation development.

1. Introduction

The biggest driving force of product technology innovation mainly comes from the profit of the market. Only the market can meet the user's product demand from the market more, and can obtain the user's profit from the market more. The harsh international market competition environment makes it difficult for some users' product requirements to be achieved technically. Therefore, technological innovation has become a key component of product innovation and design. At present, the technical innovation thinking process of the complex product design process is very complicated. Through in-depth research on the thinking process of more than 2.5 million complex technical innovation patent inventions, literature [1] proposes a technical innovation that is mainly suitable for research and analysis to solve complex practical problems. Theories and methods have continuously improved the research of technological innovation for nearly 20 years.

This article deeply explores the patterns and characteristics of designers' design thinking at different stages of the product design process and the abstract design thinking strategies and the rules of preference for their selection direction. Based on the construction of the rules of product design process, it draws on its "The "divergence-convergence" design thinking model adopts the "wide-deep-first" design thinking strategy as its implementation guideline, and proposes a product design thinking model. The model of product design thinking is closely related to the product design work strategy and the reasonable organization of enterprise human resources, making the abstract product design thinking strategy and its rules more specific and practical, which can be applied to organize and guide the enterprise product design workflow Thinking framework [2].

2. Problem solving of product modeling design

From the perspective of design logic, the design process of overall product modeling is a complex and generalized problem design and solution process. The design process and results may ultimately require not a specific final problem solving of an actual design problem, but some kind of "middle"

solution that transitions from the state of the initial design problem to the final problem solution. As the development of application scenarios of design problems changes, the solution accordingly adjusts and changes the problems accordingly. The solution process is shown in Figure 1. For the same type of design problem, the solution may also change due to different actual application scenarios [3].

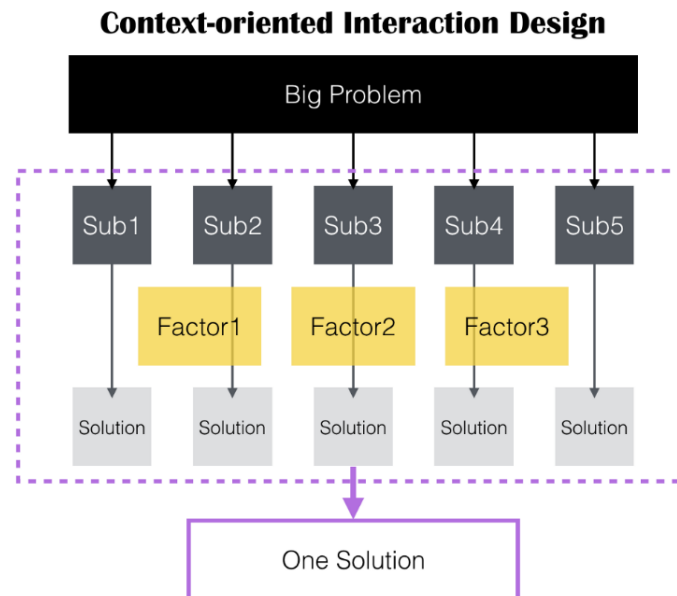


Figure 1. The same design problem solving and problem scenario

At the same time, the analog problem domain of product design problem solving cases is a typical domain of complex and poorly structured design rules. In this problem structure, the initial target state of the problem (requirements for product modeling design), the final target operating result state of the problem (result of product modeling design), and the actual operating result processing method for the problem (rules for product modeling design) It is not clear, so the problem of complex product modeling is difficult to be solved through the analogy inference process of design rules. It is necessary to complete the analog solution of product modeling problems through the expert knowledge of the product modeling designer and the experience accumulation of the designer. Reasoning process. The experience of designers and the knowledge of experts in other professional fields and the designers of product design (such as reliability, product design process, etc.) have greater logical uncertainty and ambiguity than the experience of other designers. Many product design strategies adopted by the company are based on analogy case design, through modeling and analysis of past or others, to generate new ideas and knowledge, so as to provide references for stylists and creative design. Therefore, the product design process of complex problem solving is a complex and typical analogical reasoning process [4].

2.1 Design thinking leads the problem solving process

The expression of human emotions and various physical and chemical activities has brought about the activities and production of human thinking, and when human thinking activities appear, they have greatly changed these thinking activities. So some psychologists use this analogy. He said: The generation of human thinking is like turning a huge stone into a huge pool. It will stimulate our entire existing thinking activities and waves. But this simple analogy is inappropriate because we should think of our thinking wave as a catapult caused by one thing. Because waves entering the water cause thoughts, and our thoughts expand and twist these waves. This shows that if you want a real designer to innovate in product design, you must attach great importance to its important position and role.

2.2 Basic design process of product modeling

Product design itself is a systematic product design project, so in traditional product design, it is often difficult to fully understand and accurately grasp the problem. Therefore, the product design

process often needs to be organized in an orderly manner. According to the characteristics of the product design and the regularity of the program, it reflects the different stages and aspects of the product designer’s behavior, and each link must fully demonstrate a clear product design [5].

As shown in Figure 2, it is a basic method and design workflow. Each design stage of this process should have its own methods and theories to guide the design, and the dashed lines that describe how research depicts numbers are part of the conceptual stage. Of course, this should also be an important part of a good design work formally came out before. We should first of all draw the designer's attention to this issue. We should be able to clearly understand the concept of intermittent part design. The "design" of the intermittent part at this stage includes a discussion of the modified design, a simple conceptual diagram and a three-part design. What really runs through these three design work is undoubtedly our designers' design concepts and thinking at this stage, which can be said to be their correct diagnosis and understanding of this stage of design concepts and tasks. From this idea that we can open up and develop, that is to say, we must use the completion of design work to form a more standardized model and design thinking of bionic design thinking to provide our designers with a broader design space for thinking and theoretical reference at this stage of design.

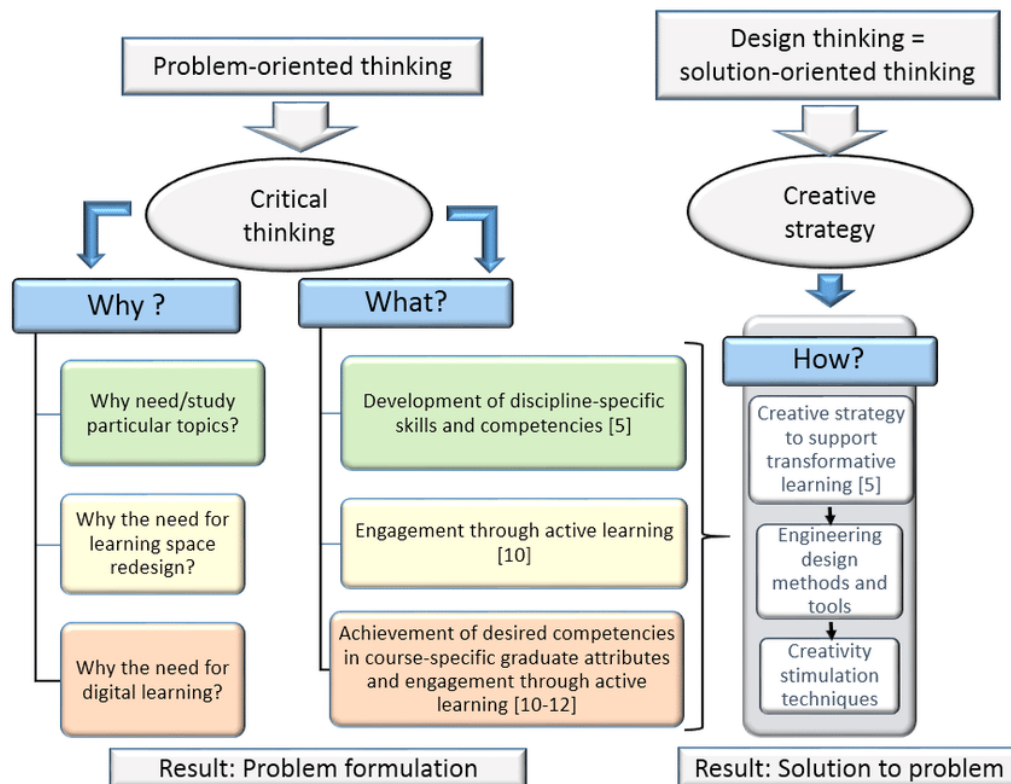


Figure 2. Basic design process of product modeling

3. First-class product design, advanced thinking model flow, product technology innovation

The design thinking process model design process can be roughly divided into three main stages in the overall plan: the task analysis from the generation plan to the plan design process, the conceptual design and task goals are determined, and the identification and analysis stages for the overall analysis of the main goals and tasks; 2 . Concept refinement and detailed concept fusion into a series of comprehensive solutions and comprehensive schemes, which are the main goals and tasks of the controllable stage; 3. The concept of controllable and a large number of design schemes are finally evaluated and selected Scheme synthesis is the stage of comprehensive scheme selection and evaluation of main objectives and tasks. Design convergence thinking is from countless various concepts. The concept of convergence in the whole process produces divergent thinking as the main mode of thinking and the concept of dominance, and the process of divergence and convergence

projects produces the main mode of divergence and convergence thinking is the dominant thinking the way.

As shown in Figure 3 is a complete design object relationship thinking unit model and data flow. Multiple design object relational thinking units directly constitute a complete design object relational thinking model. The experience of design objects in practice and the number of experience and levels of relational thinking units may also vary with the design objects and relational unit designers. Different and different. Generally speaking, the more complex the design object, the easier the designer's experience is lacking, and the greater the number of relationship unit experience and levels. The plan for integrating the core design stage adopts a multi-dimensional divergent and convergent way of thinking. By excluding specific and complex designs that do not meet the basic means of understanding and similar plans, the number of plans and specific designs is gradually reduced in an orderly manner. And eliminate complex design methods that do not conform to the original understanding and similar schemes, and gradually realize the design schemes with concrete and reduced numbers of schemes [6].

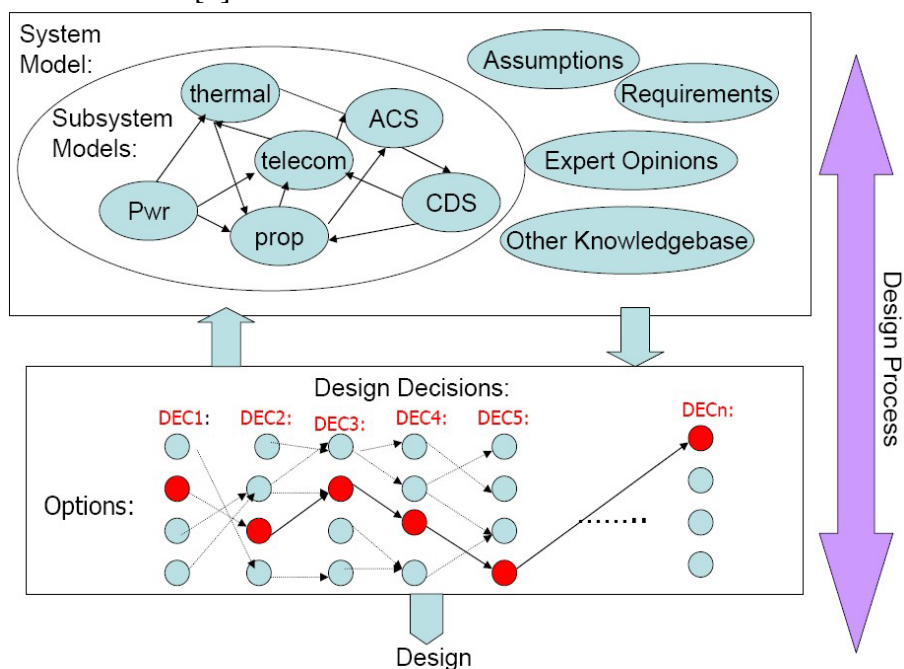


Figure 3. Complete design thinking model flow

3.1 Minimum problem

Only one electric handle can be operated independently to adjust water temperature and volume. When changing the mixing ratio of flow rate and volume, the flow temperature t must be kept constant, that is, the ratio of v_1 to the average volume flow of cold and hot water / v_2 must be kept constant, because v_1 and v_2 are synonymous changes; at the same time change the stirring and cold water Temperature t , and the volume of cold water flow than v_m cannot be changed at the same time, that is, in the United States, the ratio of hot water and $v_1 + v_2 = v_m$ must be kept constant, v_1 v_2 and v_2 should make each other antisense change.

3.2 Analysis of opposing fields and resources

The flow can be adjusted by changing the temperature and volume of the diversion by using special throttle orifice plate and throttle valve. Designers from many countries have participated in the brainstorming method, and have proposed a large number of elastomers that act on fluid shapes, such as plates, wedges, cylinders, cones, balls, and special fluid shapes. They have also successfully proposed v_m that can control fluids. And v_{vt} types of fluid movement, such as movement, rotation.

3.3 Definition of physical contradiction

And use the orifice and throttle valve to independently adjust the amount of water in the water flow. When adjusting the amount of water, the volume of cold and hot water is equal to the change of the flow rate v_1 and v_2 ; water adjusts the volume, with v_1 and v_2 as antisense changes. The water temperature is not affected by the adjusted water volume, and the water volume is not affected when the water temperature is adjusted.

3.4 Removal of physical contradictions

In the example of two different orifice control holes as evidence, there are only two pairs of two parallel straight boundaries parallel to the movement direction between the throttle adjustment parallel to the border as two of the two different orifice plates. The boundary line between the doubles is the parallel part, which fully guarantees that the two VVT throttles adjust the VVM and the parallel movement and independence. This directly determines how to ensure that the movements of the two motion regulators can make a certain rotation angle with each other and they must be a linear adjustment movement. Therefore, there must be two directions in each exchange section, two parallel four straight lines as a transverse frame, so as to avoid two completely different adjustment directions happening at the same time when adjusting a movement in a different direction, one decides to change its When moving direction.

4. Use a computer to simulate the thought process

According to the existing structured design framework for designing innovative thinking characteristic models, the framework of CAI system design workflow is established. Based on the theory of researching many existing design thinking characteristics of design innovation methods, matching and comparing the thinking characteristics of innovative system design techniques and their morphological design thinking models and characteristics with different thinking processes of designers (such as morphology) In the analysis stage, the designer uses the convergent and divergent thinking model as the main mode of thinking, and the cai integrated thinking system provides designers with innovative morphological thinking analysis that uses divergent thinking as the convergent method of thinking. Innovative thinking method morphological analysis is the main auxiliary thinking method; in the morphological comprehensive thinking stage, the designer takes the convergent thinking model as the main mode of thinking, and the cai comprehensive thinking system provides designers with the essence of abstract thinking. Convergent thinking, thinking tree Combine with the definition and conversion of thinking between trees as the main way of thinking and other assistance, etc.), provide a suitable designer at the appropriate stage and timing to innovate design technology and thought resources, inspire the designer, design for To meet the needs of its characteristic design thinking, as shown in Figure 4 [7].

organization and design resource The information push guide, for various types of design thinking and inspiring information resources, by providing various products for the various stages of design, accurately established the automation of the cai design workflow to build a variety of in line with product design internal thinking rules The automated computer software and auxiliary operating system and another application for improving the efficiency of its targeted and automated auxiliary systems provide another simple and easy-to-operate technological innovation approach.

Acknowledgements

The study was supported by “Research on Non-genetic Inheritance and Development of Cultural and Creative Products in Brocade of The Dong, China (Grant No. 18K105)”.

References

- [1] Johnson T. S. Cheng, I-Ming Jiang, & Yu-Hong Liu. Technological innovation, product life cycle and market power: a real options approach. *International Journal of Information Technology & Decision Making*, 14 (1) (2015) 93 - 113.
- [2] Wei GU, Thomas L. SAATY, & Li-Rong Wei. Evaluating and optimizing technological innovation efficiency of industrial enterprises based on both data and judgments. *International Journal of Information Technology & Decision Making*, 17 (1) (2017) 9 - 43.
- [3] Kanghwa Choi. Opening the technological innovation black box: the case of the electronics industry in korea. *European Journal of Operational Research*, 250 (1) (2015) 192 - 203.
- [4] Arman Avadykian, Stephane Lhuillery, & Syoum Negassi. Technological innovation, organizational change and product related services. *M@n@gement*, 19(4) (2016) 277 - 304.
- [5] Xi Wen Chan, Thomas Kalliath, Paula Brough, Michael O'Driscoll, & Carolyn Timms. Self-efficacy and work engagement: test of a chain model. *International Journal of Manpower*, 38 (6) (2017) 819 - 834.
- [6] M. SMITS. Formulating a capability approach based model to sustain rural sub-saharan African inhabitant's self-reliance towards their built environment. *International Journal of Sustainable Development and Planning*, 12 (2) (2017) 238 - 251.
- [7] Zhao, X., & Tao, Y. Cut-in time of historical research of chongqing friends high school as famous historic school —problem about value orientation of textual research on school history. *Chinese Studies*, 6 (2) (2017) 143 - 150.
- [8] Teresa A Marshall, Leonardo Marchini, Howard Cowen, Jennifer E Hartshorn, & David C Johnsen. Critical thinking theory to practice: using the expert's thought process as guide for learning and assessment. *Journal of Dental Education*, 81 (8) (2017) 978 - 985.