

Review of Theory, Key Technologies of Value Creation in Product Design

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Value creation is an important part of product design. Within the context of service-oriented manufacturing transformation from Goods-dominant Logic (GDL) to Service-dominant Logic (SDL) paradigm, this paper collects and analyses the relevant literatures of product value creation, and points out the focus and trends of product value creation. Those are the transformations: I. From the emphasis on the material value on the product side to the spiritual value on the customer side; II. The shift from the value of use and the value of the economy to *Kansei* value of added value; III. From consideration of value creation of single product under the customer perspective to comprehensive consideration of relationship and structure of production, distribution, transfer and use of product value among the value chain, value network including product stakeholders; IV. From static value creation to dynamic value co-creation of product in time dimension. Furthermore, the study concretely analyses the research progress and trends of theory, technologies of value creation in product design by the Quantitative Type III and Cluster analysis.

Keywords: *Service Product Design ; Value creation ; Kansei value ; Quantitative Type III ; Cluster analysis*

1 Introduction

In the era of Industry 4.0, intelligent technology systems have become a new kinetic energy to guide economic development. The continuous innovation of technologies such as mobile Internet, Internet of Things, and people's networking is driving the development of industrial design. The design paradigm has undergone a transition from "Product-centred · Economic priority" to "User-centred · Life priority". The focus of product innovation shifts from the usability design of mass manufacturing products to the emotional and experiential design of personalized products and services. In the context of improving quality and efficiency in manufacturing, and transforming and upgrading services, creating high added value has become the key for enterprises to win core competitiveness in the fierce market competition. The Japanese industry calls this high added value as *Kansei* value, which is the fourth value axis in addition to high performance, high reliability and low price (Ministry of Economy, Trade and Industry, 2007). *Kansei* value creation is the core of service product design (Dongxiao Chu, 2014). Systematic research and combing the value creation theory in the

design of existing service products is an important step for enterprises to create high added value and enhance the core competitiveness of the product market.

2 Service product value creation

2.1 The value of the service product

The word Value first appeared in the field of economics. In the 17th century, British economist William Petty first proposed the theory of labour-determined value, that is, the labour time spent on producing goods determines the value of goods. British economist Nicholas Barbon put forward the theory of utility value, emphasizing that value comes from the utility of the goods and focuses on the usefulness of the goods. In 1750, Italian economist Ferdinand Galliani proposed that scarcity can increase utility, and his research extended from labour-determined value and utility-determined value to the extended value of marginal utility.

Under the dominant logical paradigm of artefacts, the semantic evolution of artefacts as industrial design objects has gone through three stages: "Goods → Products → Commodities". The focus of product value research has experienced "Use value → Exchange value → Economic value". The transfer of consumer demand for product design has undergone a three-stage transition of "Usable → Convenient → Humanized" (Dongxiao chu, Xueman Chu, & Yujie Peng, 2017).

Under the Service-Dominant Logic paradigm, the product is a service-dominant product, which is essentially a "Service Product". The connotation includes "Service" and "Product" that are created. The most important feature is to create *Kansei* value Which can bring happiness and benefit to the people (Dongxiao chu, Xueman Chu, & Yujie Peng, 2017). In design research, the value of service products can be divided into two categories: material value and spiritual value. The material value includes the use value and economic value. The economic value is essentially an exchange value; the spiritual value can also be called *Kansei* value (Dongxiao Chu, Ono Kenta, Terauchi Fumio, Walanabe Makoto, & Aoki Hiroyuki, 2010). In addition, scholar Anderson and other scholars believe that value is customer perceived utility relative to purchase price, reflected in economic, technical, service and social benefits and so on. The traditional value creation view believes that value is the objective existence of functional value, which exists in the presence of products, and enterprises can carry out unilateral production. The modern value creation view considers value as a subjective experience, a consumer's psychological activity, and product value cannot be separated from the participation and creation of consumers.

In the process of "creating goods" to "making meanings", the service products require products to pay more attention to the "meaning" on the basis of paying attention to the "production" itself, and arouse the emotional mutual feeling and association of consumers. It is the focus of service product design and development (Dongxiao chu, et al., 2017). At this point, consumers pay more attention to the emotional experience when they buy products and services. What consumers need is no longer specific products, but the utility provided by these products and services (Mont,O.,2003).The mining of value growth points of enterprises has also shifted from product to human research. The focus of product value creation also shifts to *Kansei* value creation. The emotional value (Naisbitt,J. & P. Aburdene, 1991) generated by high sentiment (Ministry of Economy, Trade and Industry, 2007) (The fourth value axis "+a" value) has made a great contribution to product value creation.

2.2 Emotion and product value

Emotion defines the core content of the experience, and leads the generation of decision-making, establishing a personal relationship between things and people. The process by which consumers consume products and services is a process of emotional experience. The generation of consumer behaviour is the decision made by the consumer through irrational

decision-making and rational judgment (Damasio A R., 2015), and then subconsciously perceives the interpretation of the product's emotion and establishes a relationship with its personalized deduction (Reeves, Nass, 1996). Creating models through research on perceptual and *Kansei* value helps to capture the emotional needs of consumers in different areas. At the end of the 19th century, the psychologist William James began to study emotions. Designed for emotion, in 1962 Robert Plutchik (1962) proposed an emotional model to describe how different emotions are related. In 2000, Jordan proposed the type of user interest to describe the different types of interest values that products bring to consumers (Jordan, 2000). In 2004, Norman proposed a perceptual three-level theory (Donald A. Norman, 2004). In 2008, Demir proposed three types of reactions: automatic response, feelings generated through interaction, and relationships established in the time dimension (Erdem DEMİR, 2008). In 2012, the Japanese Association of Sensible Workers proposed a three-level theory of *Kansei* value creation (Ministry of Economy, Trade and Industry, 2007).

In industrial design, Artificial Intelligence (AI) introduced embedded technology into product design, which made the operation mode, function and usage scenario of products develop towards software operation related to the Internet of Things. Artificial Intelligence focuses on user experience in human-computer interaction (Fan, Fan, & Tian, et al., 2019). Research on human emotion or emotion generation mechanism has an effective guiding role for user experience. Artificial intelligence can be divided into human + machine + intelligence, that is, to import emotions into the machine, so that the machine can achieve the same way of thinking as human to deal with problems, and gives the same emotions to the machine. Through the emotional communication between machines (products) and people, consumers can resonate. Then the resonance triggers the spiritual value of consumers in the service experience process, and urges them to make decisions such as purchasing. David Chalmers, a philosopher and cognitive scientist, divided the problem of understanding human consciousness into "simplicity" and "difficulty". For Artificial Intelligence, the simple problem is to create a robot that can simulate human emotions. This kind of problem can be measured by the standard method of cognitive science. The difficulty is to create a robot that can feel people's emotions. This kind of problem belongs to the problem of experience. Technological innovation under the intellectualized transformation promotes *Kansei* value creation of service products.

3 Value creation theory system and application

Exploring the value growth point and development direction, researching the added value of products first needs to understand the evolution of different dominant logics of the value creation mechanism. Combined with the value model, comprehensive consideration of value to create the impact of various stakeholders on product design and value creation dimensions is an effective way to maintain or enhance products, and has important guiding significance for the future development of value creation.

3.1 Evolution of the dominant logic paradigm

First of all, to study the product value creation in service product innovation, we should understand the core ideas of different dominant logic paradigms. From the perspective of marketing, the dominant logical paradigm of value creation can be divided into the following three categories according to its different cores: from the perspective of producer providers, it can be divided into Goods-Dominant Logic and Service-Dominant Logic (Vargo & Lusch, 2004); in contrast, in the non-productive perspective, Customer-Dominant Logic and Memory-Dominant Logic (Harrington, Hammond, & Ottenbacher, et al., 2018).

In traditional manufacturing, mechanized mass manufacturing-oriented Goods-Dominant Logic (GDL) emphasizes that companies create value through products and technologies. Consumers purchase products of different categories to meet psychological needs and obtain the reputation and status of the products, while product value creation is terminated when consumers purchase (Jallat, 2004). With the transformation of manufacturing services, there has been a shift from "product-centric" to "service-centric". Under Service-Dominant Logic (SDL), product value creation is no longer limited to the manufacturing of enterprises, but more concerned with the design and service-related contacts and the establishment of multi-relationships to enhance consumers' experience in purchasing products and using them. Through the provision of production-related service systems, enterprises create co-creation with consumers (Vargo & Lusch, 2004; Vargo & Lusch, 2008) and form a systematic value network (Kothandaraman & Wilson, 2001).

From a non-productive perspective, in Customer-Dominant Logic (CDL), Anderson and others believe that value is customer perceived utility relative to purchase price, which is reflected in economic, technological, service and social benefits. Value is the psychological activity of consumers and a subjective experience. The value of products cannot be separated from the participation and creation of consumers. In Memory-Dominant Logic (MDL), enterprises not only pay attention to how service experience affects consumers' satisfaction and loyalty, but also pay more attention to how to create value according to the uniqueness and individuality of experience to promote consumers to produce sustainable memories. Good memory, as a consumer's consumption decision transformed from experience, can bring potential competitive advantages to enterprises (Harrington, Hammond, & Ottenbacher, et al., 2018).

The development of the dominant logic paradigm has gone through four stages: from Goods-Dominant to Service-Dominant to Customer-Dominant to Memory-Dominant. From a productive enterprise perspective, it is not just the value-added creation of products, but how the utility provided by these products and services creates value with consumers and focuses on the importance of collaborative innovation (Rich, 1999).

3.2 From the traditional value axis (+a) to the fourth value axis

In the field of product design, the traditional value axis focuses on creating value from the enterprise, and consumer purchasing decisions result from an assessment of the weight of the product's function and price. For consumer groups with different abilities, on the basis of satisfying the function, whether the price meets the expectations of consumers becomes the key to decision-making. Service-oriented products, powerful features and low prices can no longer meet the needs of consumers. Different from the (+a) fourth value axis of the traditional value axis, Kansei value is incorporated into the core of value creation, focusing on creating emotional resonance. Enterprises create their Kansei value by providing quality service by telling story and making meaning (Dongxiao Chu, 2017) to attract consumers, and through consumer feedback on products, decide whether to enhance the corresponding emotional attributes, such as relaxation, security, and friendliness. The culture, technology, service, and emotion that the enterprise gives to the product will directly affect the consumer's evaluation of the product. Consumer feedback on the product will also become an important basis for product iteration improvement.

3.3 Value models

Currently, in the field of economic management, based on the dominant logic paradigm, in the perspective of producers: Michael E. Porter proposed the Value Chain in the book *Competitive Strategy* in 1980. It is used to explain the value activities carried out by the company in the whole life cycle of the product. It mainly focuses on the value activities in the chain that can bring economic benefits to the enterprise, and brings strategic advantages to the enterprises in the face of competition. In the non-productive perspective: Adrian Slywotzky proposed the Value Network in the book *Profit Zone*, emphasizing that companies should break the traditional value creation logic and benefit relevant people are integrated into the value chain, paying attention to user needs and user preferences in order to face market-level competition, and then achieve a win-win situation.

Secondly, in the field of service product design, it is helpful to understand the key points of service product value creation by combining the core viewpoints of existing scholars and services and the theoretical models related to service product value creation. From the perspective of the service process, Tomiyama (2001) pointed out that service is an activity that changes the state of the recipient; Yoshikawa Hiroyuki (2008) believes that service is the result of a behavioural output, and this behaviour comes from the engine Feedback from the output of the next; From the perspective of service science, IBM research departments pay more attention to the interactions generated by the recipients in the service process. At the same time, the "IHIP" model of services (Naito, 2009) indicates that the service itself has intangibility, heterogeneity, inseparability and perishability. These abstract features of the service itself make the service design activities more concerned with the maintenance of intangible relationship elements and co-creation through such services. Service-related models In addition to the IHIP model, Ueda, Takenaka, Fujita (2008) pay attention to the interaction between artefacts, people and the environment, nature and social environment, and propose the Ueda model based on the content created by the service value: Type I providing values, Type II adaptive values and Type III co-creative values. Shimomura, et al (2005) pay attention to the content of the service, the channel, and the state change after the recipient receives the service. It believes that the value of the service can be assessed by the state change generated by the recipient after experiencing the service, and subjectively based on the service. The characteristics propose "flow model", "scope model" and "view model", collectively referred to as Shimomura model (Shimomura, et al, 2003). Based on the above service value creation model, it can be seen that the service value creation focuses on the interaction between "goods + people + market + environment" (Dongxiao Chu, 2014), and on this basis, the development direction of product value creation is sorted out by studying relevant literatures of scholars.

4 Research hot-spots and development trends

4.1 Analysis methods and processes

Through the integration of 50 research papers related to value creation, 37 keywords were extracted, and the research status of value creation was analysed and summarized by using quantitative Type III and cluster analysis methods. According to the results of cluster analysis, 37 keywords are classified into five groups of G1-G5 (Fig.1), and then these keywords are marked by spatial points to generate 1-2 axis distribution by visual method (Fig.2).

G1 mainly studies the value creation of the static value dimension of products from the perspective of human-computer interaction. Research on product form image and symbolic semantics from a product perspective. Using product family design (Bin Zhu, Pingyu Jiang & Jianning Su, 2004) and sensibility engineering (Shijian Luo & Yunhe Pan, 2007; Junsheng Kuang & Pingyu Jiang, 2007) and other methods, pay attention to the relationship between product shape and user demand preferences, optimize product design, mostly used in CAID field (Xiaopeng Hou, Suihuai Yu & Wen Zhao, 2008). Focusing on product aesthetics and emotional experiences from a user perspective, the goal is to create value through product + user (Mcdonagh, Bruseberg, & Haslam, 2002). Based on the user's cognition, the main focus is on how to create product *Kansei* value by researching the symbolic semantics of products and realize value growth; and through ergonomics, pay attention to the aesthetic problems of products under visual perception (Mcdonagh, Bruseberg, & Haslam, 2002).

G2 is a study of product dynamic value creation from a time perspective, considering *Kansei* value creation and change of time factors. Mainly concerned with value transfer and value evolution (Xiaopeng Hu, 2004), through product life cycle management and evaluation, timeline design and other methods to study the evolution and transfer of product value in the time dimension (KamiyaK, Kito, Alvarez, et al., 2014). G3 is a technology and method perspective, focusing on the sustainable design of products, focusing on green sustainable value creation on the product life cycle based on the G2 time dimension (Jing Li, Fangyi Li, Lirong Zhou, Xingshuo Xu & Qiang Meng, 2016), and through colour image research(Man

DING, Wei SUN, Jiang XU, & Xu ZHANG, 2011), emotional calculation (Kun Huang, 2007), BP neural network(Lai, Lin,& Yeh,2005; Lai, Lin,& Yeh,2006), sensitivity analysis (Jing Li, Fangyi Li, Lirong Zhou, Xingshuo Xu & Qiang Meng, 2016) and other methods to integrate user perception into product design.

Both G4 and G5 conduct research on the value creation of service products from the perspective of management and marketing. Among them, G4 mainly studies *Kansei* value based on customer relationship from the perspective of management and marketing (Hald, Cordón, & Vollmann, 2009; Smals & Smits, 2012); from the perspective of management and strategy, studies the creation of *Kansei* value under new technology (Rayna & Striukova, 2016). G5 focuses on service quality and consumer demand. From the perspective of consumer behaviour, we mainly focus on marketing and value creation based on value co-creation (VCC) (Yi, & Gong, 2013). Using QFD and other methods, focusing on the key demand of consumer satisfaction, from the perspective of service and quality, we study the problem of *Kansei* value creation such as perceptual quality and quality characteristics (Shijian Luo & Shangshang Zhu, 2005). And from the cognitive level to face the invisible needs of consumers to explore, to optimize the quality of service. Enhance consumer satisfaction and achieve product value creation through the joint efforts of culture, service and quality.

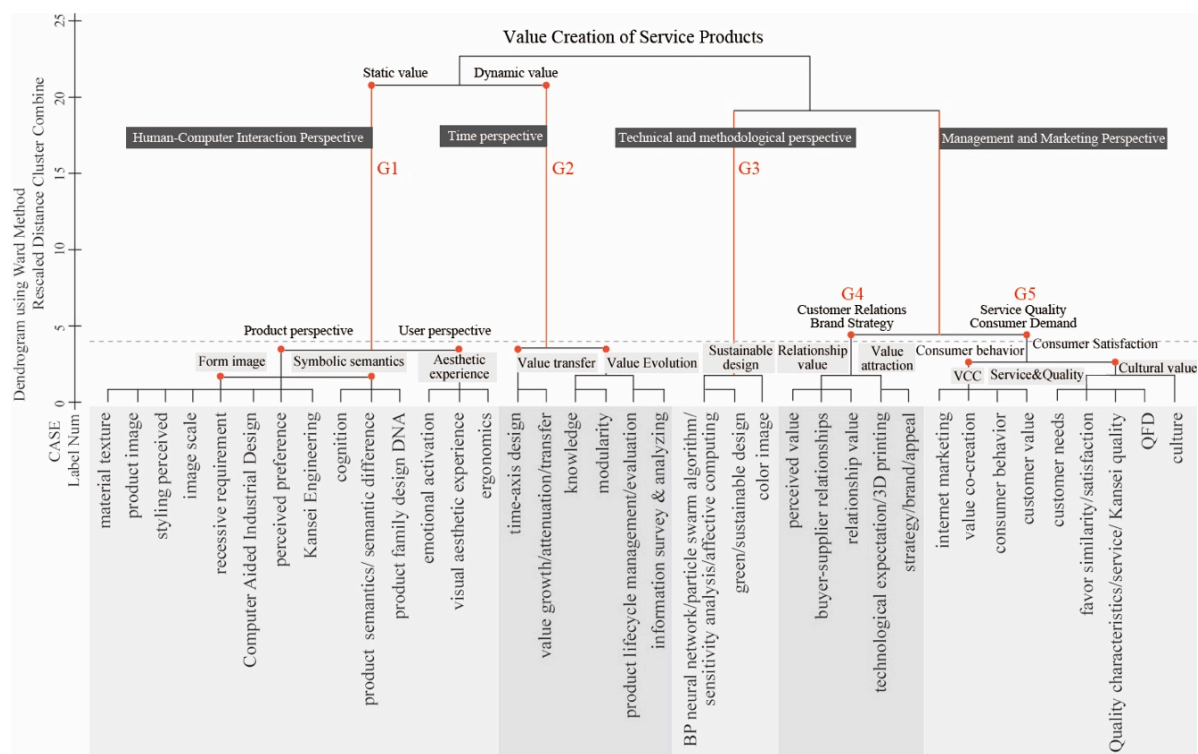


Figure 1. Keyword Hierarchical Clustering Analysis Diagram.

4.2 Analysis results

From Fig.2 (1-2 axis distribution map), we can see the related technologies, hot-spots and development trends of value creation research. At present, the value creation of service products mainly focuses on human-computer interaction (G1), time (G2), technology and method (G3), management and marketing (G4, G5). Among them, human-computer interaction and management and marketing focus on the research applications of *Kansei* value creation, service quality, brand strategy and consumer demand. At the same time, based on the value evolution, value transfer and product life cycle management evaluation, the time factor is included in the service product value research, and *Kansei* value creation and change research considering the time factor is also an important development direction for the service product value creation in the future.

Based on the background, the results of the cluster analysis based on Fig.1 and Fig.2 can lead to the following four changes in the value creation research in product design:

1 From the emphasis on the material value on the product side to the spiritual value on the customer side (Dongxiao Chu, Ono Kenta, Terauchi Fumio, Watanabe Makoto, & Aoki Hiroyuki, 2010). Focusing on products, G1 studies the contribution of product design to product material value creation by focusing on material texture, modelling characteristics, symbolic semantics, ergonomics, and visual aesthetics. Furthermore, by focusing on the user's cognitive scale and the continuity of product DNA design, we pay attention to the semantic difference of products, and based on user cognition and image scale, we study the contribution of product sensibility image to value creation. Focusing on consumer behaviour, consumer potential needs, satisfaction, and social networks, G5 focuses on enhancing the spiritual value of products and achieving value creation. From product-centric to consumer-centric, the focus of product design has changed.

2 The shift from the value of use and the value of the economy to *Kansei* value of added value. Based on technology-driven design and oriented towards sustainable design goals, G3 focuses on the application of *Kansei* value creation methods. Combining G1 and G5 research on product image and user cognition and consumer demand, through emotional calculation and perceptual engineering, it emphasizes the importance of product *Kansei* value to contribute to product value creation.

3 The value creation of individual products from the perspective of customers to the comprehensive consideration of the value chain of product stakeholders, the transformation of the value production, distribution, transfer and use of value networks. G3 and G4 are distributed in the position where the first, second and third quadrants are close to the origin in Fig.2, comprehensive technical methods and brand strategy management, comprehensively study the contribution of multi-dimensional factors to value creation. G4 has two subsets, one that reflects research expectations, attractiveness, and the contribution of the buying and selling relationship to the value of the product relationship. Second: reflect the leading role of technology in brand strategy. The G3 and G4 regions focus on external factors such as social background, strategic relationship, and development goals for products. On the basis of G5, we study the contribution of various factors to product value creation in the context of complex extension.

4 Complex multi-dimensional changes such as the transition from static value to dynamic time dimension value creation. G1 and G2 are distributed in the first quadrant partially, which focuses on the study of *Kansei* value of service products. The emotions are studied through factors such as colour, material, modelling, image, semantic symbols and other factors. Incorporate service products. Most of G2 is distributed in the second quadrant, which focuses on the study of the dynamic value of service products in a comprehensive context. Combined with (3) simultaneous inclusion of time factors, through the timeline design, product life cycle and other design methods to study the multi-dimensional changes in value creation in the context of time dimension.

From the keywords distribution of Fig.2, the value creation of service products has experienced the development from product to user, from material to spiritual, from single to system, from static to dynamic. Among them, the study of the creation and change of *Kansei* value considering the time factor (Matsuoka Yoshiyuki, 2009) will be the focus of research on the future development of service products.

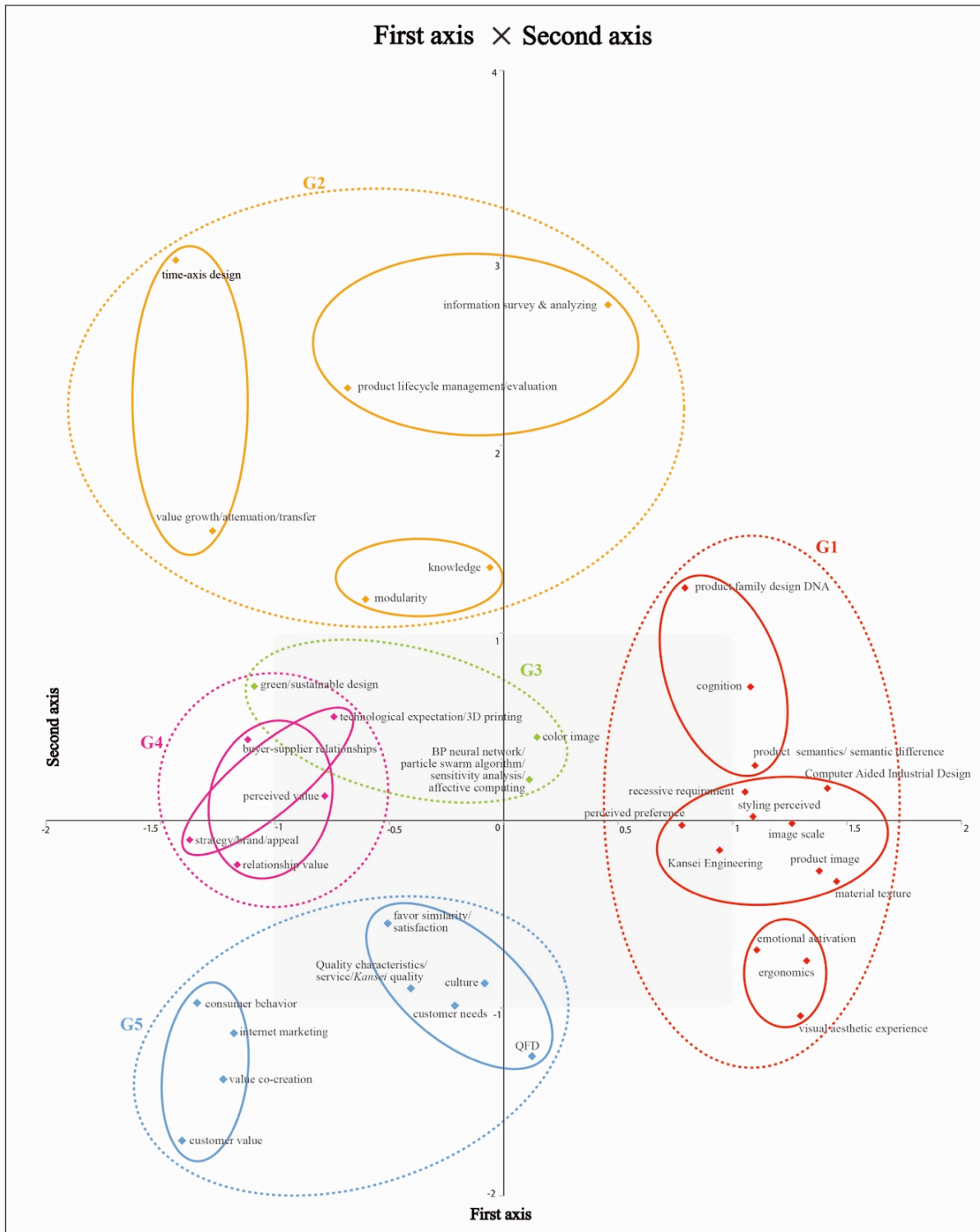


Figure 2. Keyword Scatter Distribution Map (1-2 Axis).

5 Conclusion

This paper studies the value creation of service products, and concludes that the value creation of service products has changed in four directions through quantitative research methods such as cluster analysis. The transformations are as follows. From the emphasis on the material value on the product side to the spiritual value on the customer side; II. The shift from the value of use and the value of the economy to *Kansei* value of added value; III. From consideration of value creation of single product under the customer perspective to

comprehensive consideration of relationship and structure of production, distribution, transfer and use of product value among the value chain, value network including product stakeholders; IV. From static value creation to dynamic value co-creation of product in time dimension. Among them, it is found that the value creation of service products mainly focuses on the aspects of cognition, perception preferences, user needs and so on from the user perspective, and from the product perspective mainly focuses on the aspects of symbolic semantics and morphological images and so on. And then, combining the technical analysis methods (such as neural network, sensitivity analysis) and market management and marketing, it shows the trend of developing from static to dynamic research on *Kansei* value creation. For designers or design researchers, it is necessary to further study the creation of *Kansei* value in dynamic time dimension with the combination of new technology and multi-disciplinary domain knowledge. This is also the next step of this study.

6 References

- Bin Zhu, Pingyu Jiang, & Jianning Su. (2004). Study on identification of product platform parameters based on Kansei Engineering. *Chinese Journal of Mechanical Engineering*, 40(2), 87-91. doi : 10.3321/j.issn:0577-6686.2004.02.019
- Dongxiao Chu. (2014). Current Situations of Product Value Creation Based on Time axis Design. *Packaging Engineering*, 35(4):66-69.
- Dongxiao Chu, Xueman Chu, Yujie Peng. (2017). Research on Service Product Design from "The Beauty of Creation" to "Change of Meaning". *Packaging Engineering*, 38(10): 37-41.
- Dongxiao Chu, Ono Kenta, Terauchi Fumio, Watanabe Makoto, Aoki Hiroyuki. (2010). Analysis of Value Co-creation in Service and Product Design. *Bulletin of Japanese Society for the Science of Design*, 57(3): 87-96
- Dongxiao Chu.(2014) Development of Service & Product Design Based on Product Life Cycle Viewpoint, *China: Wuhan University Press*,pp61
- Damasio, A. R. (2015). Descartes' error: emotion, reason, and the human brain. *Psychosomatics*, 310(36), 151–153. doi: 10.1016/S0033-3182(95)71686-3
- Erdem DEMİR. The field of design and emotion: Concepts, arguments, tools, and current issues [J]. *METU JFA*, 2008, 25 (1): 135.
- Fan X M, Fan J J, Tian F, et al. (2019). Human-computer interaction and artificial intelligence: from competition to integration. *China: Scientia Sinica Informationis, SCIENCE CHINA PRESS*.49: 361–368, doi: 10.1360/N112018-00181
- Harrington, R. J. , Hammond, R. K. , Ottenbacher, M. C. , Chathoth, P. K. , & Marlowe, B. . (2018). From goods-service logic to a memory-dominant logic: business logic evolution and application in hospitality. *International Journal of Hospitality Management*. doi: 10.1016/j.ijhm.2018.05.014
- Hald, K. S., Carlos Córdón, & Vollmann, T. E. (2009). Towards an understanding of attraction in buyer–supplier relationships. *Industrial Marketing Management*, 38(8), 960-970. doi: 10.1016/j.indmarman.2008.04.015
- Jallat, F. (2004). Reframing business: when the map changes the landscape. *International Journal of Service Industry Management*, 15(1), 122-125(4). doi: 10.1108/09564230410523367
- Junsheng Kuang, & Pingyu Jiang. (2007). Product Configuration Design with Customization Mode Bases on Kansei Engineering. *Journal of Computer-Aided Design & Computer Graphics*, 19(2), 178-183. doi : 10.3321/j.issn:1003-9775.2007.02.008
- Jing Li, Fangyi Li, Lirong Zhou, Xingshuo Xu, & Qiang Meng. (2016). Sensitivity analysis for life cycle assessment of product based on back propagation neural network. *Computer Integrated Manufacturing Systems*, 22(3). doi: 10.13196/j.cims.2016.03.010.
- 'Kansei' Initiative: Suggestion of the fourth value axis, Ministry of Economy, (2007). Trade and Industry, JAPAN, May
- Kothandaraman, P., & Wilson, D. T. (2001). The future of competition: value-creating networks. *Industrial Marketing Management*, 30(4), 379–389. doi: 10.1016/S0019-8501(00)00152-8
- Kamiya, K., Kito, A., Alvarez, J., Sato, K., Nishimura, H., & Matsuoka, Y., et al. (2014). Time axis design of a service system growing values of mobility using the m-v model. doi: 10.1007/978-3-319-07635-5_28
- Kun Huang. (2007). An overview on affective information processing. *NEW TECHNOLOGY OF LIBRARY AND INFORMATION SERVICE*, 2(11). Doi: 10.3969/j.issn.1003-3513.2007.11.014

- Lai, H. H., Lin, Y. C., & Yeh, C. H. (2005). Form design of product image using grey relational analysis and neural network models. *Computers & Operations Research*, 32(10), 2689-2711. doi: 10.1016/j.cor.2004.03.021
- Lai, H. H., Lin, Y. C., Yeh, C. H., & Wei, C. H. (2006). User-oriented design for the optimal combination on product design. *International Journal of Production Economics*, 100(2), 253-267. doi: 10.1016/j.ijpe.2004.11.005
- Matsuoka Yoshiyuki. (2009) The 56th Annual Conference of the Japan Society for the Science of Design Organized Session (D): Age of time axis design, Nagoya
- Man DING, Wei SUN, Jiang XU, & Xu ZHANG. (2011). Product Colour Fuzzy Optimum Design Considering Colour Image Uncertainty. *Chinese Journal of Mechanical Engineering*, 47(12), 185-190. doi:10.3901/JME.2011.12.185
- Mont, O. (2003). Editorial for the special issue of the journal of cleaner production on product service systems. *Journal of Cleaner Production*, 11(8), 815-817. doi: 10.1016/S0959-6526(02)00163-4
- Mcdonagh, D., Bruseberg, A., & Haslam, C. (2002). Visual product evaluation: exploring users' emotional relationships with products. *Applied Ergonomics*, 33(3), 231-240. doi: 10.1016/S0003-6870(02)00008-X
- Naisbitt, J. And P. Aburdene (1991). 2000 megatrend. *Beijing: China Renmin University Press*
- Norman, D. A. (2004). Emotional design. Ubiquity. doi: 10.1145/985600.966013
- Naito K., Service Engineering, *university of Tokyo press*, 25, 2009.
- Reeves B, Nass C I. (1996) The media equation: How people treat computers, television, and new media like real people and places. doi: 10.1016/S0167-6393(97)00049-6
- Plutchik. (1962). The emotions: facts, theories, and a new model. *American Journal of Psychology*, 77(3), 518. doi: 10.2307/1421040
- Patrick W. Jordan. Designing Pleasurable Products: An Introduction to the New Human Factors by Patrick W. Jordan[M]. 1st ed. London, CRC Press, 2000
- PigneurY. An ontology form-business models[C] // International Conference on Conceptual Modelinger. DBLP, 2002.
- Rayna, T., & Striukova, L. (2016). From rapid prototyping to home fabrication: how 3d printing is changing business model innovation. *Technological Forecasting & Social Change*, 102, 214-224. doi: 10.1016/j.techfore.2015.07.023
- Rich, M. K. (1999). Business market management: understanding, creating, and delivering value. Prentice Hall. doi: 10.1108/08858629910272265
- Shijian, L., & Shangshang, Z.. (2005). An experimental study of users' product form perception. *Packaging Engineering*. Doi: 10.3969/j.issn.1001-3563.2005.03.069
- Shimomura Y., etc., c (1st Report, Service Modeling Technique for the Service Engineering), *the Japan Society of Mechanical Engineers*, 71, 702, 2005.
- Shimomura, Y., Watanabe, K., Arai, T., Sakao, T., & Tomiyama, T. (2003). A proposal for service modelling. *International Symposium on Environmentally Conscious Design & Inverse Manufacturing. IEEE*. doi: 10.1109/ECODIM.2003.1322641
- Shijian Luo, & Yunhe Pan. (2007). Review of theory, key technologies and its application of perceptual image in product design. *Chinese Journal of Mechanical Engineering*, 43(3), 8-13. doi : 10.3321/j. issn:0577-6686.2007.03.002
- Smals, R. G. M., & Smits, A. A. J. (2012). Value for value—the dynamics of supplier value in collaborative new product development. *Industrial Marketing Management*, 41(1), 0-165. doi: 10.1016/j.indmarman.2011.11.022
- Tomiyama, T. (2001). Service engineering to intensify service contents in product lifecycles. *Ecodesign: Second International Symposium on Environmentally Conscious Design & Inverse Manufacturing. IEEE*. doi:10.1109/.2001.992433
- Ueda, K., Takenaka, T., & Fujita, K. (2008). Towards value co-creation in manufacturing and servicing. *CIRP Journal of Manufacturing Science and Technology*, 1(1), 53-58. doi: 10.1016/j.cirpj.2008.06.007
- Vargo, S. L., & Lusch, R. F. (2004). Evolving to a new dominant logic for marketing. *Journal of Marketing*, 68(1), 1-17. Doi: 10.1509/jmkg.68.1.1.24036
- Vargo, S. L., & Lusch, R. F. (2008). Service-dominant logic: continuing the evolution. *Journal of the Academy of Marketing Science*, 36(1), 1-10. doi: 10.1007/s11747-007-0069-6
- Xiaopeng Hou, Suihuai Yu, & Wen Zhao. (2008). Research on the material texture CAID system of product based on Kansei engineering. *MODERN MANUFACTURING ENGINEERING (12)*. doi : 10.3969/j.issn.1671-3133.2008.12.015

- Xiaopeng Hu. (2004). Modulization of Value System and Value Transfer. *CHINA INDUSTRIAL ECONOMY* (11). doi : 10.3969/j.issn.1006-480X.2004.11.010
- Yoshikawa H., Introduction to theory of service engineering: framework for theoretical study of service engineering, *Synthesiology*, 1, 2, 2008
- Yi, Y., & Gong, T. (2013). Customer value co-creation behavior: scale development and validation. *Journal of Business Research*,66(9), 1279-1284.doi: 10.1016/j.jbusres.2012.02.026

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