Satisfying Consumers' Needs through Systematic Empathic Design Model

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Abstract. Customer-oriented customized design has become the key success factor in the process of product development. However, designers are typically unable to identify the actual demands of consumers to conduct customized designs because of numerous limitations. These limitations include consumers' lack of expressive abilities to clearly highlight their demands and designers' lack of measures and methods to effectively integrate consumer opinions. Thus, based on the proposed systematic empathic design model, the primary purpose of this study is to identify consumer demands. These demands can be identified by initially conducting participant observations to describe phenomena and applying the laddering method to obtain information. Then, the implication matrix was employed to facilitate analysis and the hierarchical value map was used to ensure the formulation and setting of the guidelines for demand. Finally, mind mapping was used to develop conceptual prototypes of the products. Through this combined process, customer satisfaction is achieved. This study contributes to the design industry by providing designers with a closely coordinated and clearly visible set of procedures for the initial stages of design process. This study endeavors to effectively satisfy the implicit demands of consumers and develop prototypes of customized products.

Keywords: Systematic Empathic Design Model, Customization, Consumer Demand, Concept Prototype.

1 Introduction

The current economic model has shifted from a production-oriented to a consumer-oriented model. Novel product development concepts have also evolved from highlighting production capacity enhancement, new techniques development, and better management methods formulation in the past, to the development of methods based

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on consumer demands that endeavor to identify and satisfy consumers' feelings towards products. Thus, under fixed constant variables, products that are co-manufactured with the participation of consumers gain greater preference among consumers [1]. The process of developing novel products is categorized into 4 stages, specifically, opportunity identification, development, optimization, and launch. Subsequently, successful novel product development is significantly influenced by whether opportunity identification accounts for the unmet needs of consumers [2]; thus, "listening to consumer aspirations" and "satisfying consumer needs" are focal topics that are vigorously discussed in modern product design. However, consumers' product demands typically change dynamically, are abstract and ambiguous, and are even unclear to the consumers themselves; therefore, methods to identify and convert these demands into approaches for design development have become key issues in the product development process. In other words, to truly achieve customization value, issues of specifying consumer satisfaction through design and identifying consumer needs should first be addressed; subsequently, demand trends should be anticipated prior to consumer recognition and applied in product design.

Consumers primarily take interest in certain products when these products retain specific significance to them. This significance originates from cognition, and is also the assessment criterion that determines purchase intention [3]; however, a gap exists between the cognitive models of designers and consumers [4]. In an age of product diversity, designers should extend beyond their trained and internalized thinking patterns when analyzing the consumer demands and preferences. Empathic design is a consumer-oriented design procedure that emphasizes the detailed observation of various phenomena that occur during the consumers' use of products. Consequently, by analyzing and understanding the produced affective viewpoints, customized products can be provided to individual consumers. However, the implementation of empathic design demands experiences and is extremely time consuming. Unlike traditional surveys, empathic design highlights the observation of consumers' daily lifestyles to collect five types of information otherwise difficult to obtain [5], specifically, data regarding triggers of use, interactions with the user's environment, user customization, intangible attributes of the product, and unarticulated user needs. Despite the general consensus regarding the importance of consumer demand and the various survey techniques that have been developed [6, 7, 8]; a specific method incorporating empathic design into product customization has yet to be established in the design industry. Thus, this study proposed the systematic empathic design model. This model was initially used to identify consumer opinions. These opinions were then analyzed and used to confirm consumer demands and formulate a product pre-development design orientation that expedites a product development trend capable of satisfying consumers.

2 Literature Review

2.1 Customization in Product Design

To obtain correct consumer demands, and subsequently tailoring these demands, is the first step in executing customization. In addition to considering market trends in the development of customized products, the planning and design of individual

demands should be specifically incorporated into the numerous stages of design, manufacturing, and delivery [9]. Subsequently, adopting one-on-one methods to obtain customization demands is not only uneconomical, but also ineffective; thus, incorporating consumer preferences into product design is the primary challenge that is presented during customization processes. Customization elements should be considered in the design stage of a product to provide an entry point for consumer participation in product customization [10]. Based on practical observations, the customization can be sequentially categorized into four superficial to detailed dimensions, specifically, cosmetic, adaptive, collaborative, and transparent [11]. Customization demonstrates competitive advantage by diversifying products, changing products according to consumer demands, rapidly reflecting market shifts, and providing consumers with personalized products.

2.2 The Laddering Technique, Implication Matrix, and Hierarchical Value Map (HVM)

Products are stored as hierarchical structures of significance in one's cognitive memory; that is, the cascade process of product attributes, consumption consequences, and personal values. Consumers place greater value on attributes that are linked upwards to a more abstract value hierarchy [3]. These links can further be further categorized into six sub-hierarchies, specifically, physical characteristics, abstract characteristics, functional, psychosocial, instrumental-external, and terminal-internal [12]. The laddering technique is the most commonly applied qualitative method to collect means-end chains (MECs), which executes direct eliciting interviews to uncover the underlying values of consumers [13]. The main advantage of this technique is that it is able to retain the terms participants have selected during their descriptive decision-making process. This is particularly important because of the rapidly-changing use of language by present-day young people [14]. Pilot tests that were based on the categorization method proposed by Olson and Reynolds (1983) have found that the majority of consumers were unable to clearly describe the physical characteristics, abstract characteristics, instrumental-external, and terminal-internal hierarchies, but were able to clearly describe the functional and psychosocial hierarchies. In addition, numerous study results based on the laddering technique [14, 15, 16,] clearly suggested that the linking relationships in the MEC consequences hierarchy were significantly more intricate. Thus, this study retained the attributes and values hierarchies, but further categorized the consequences hierarchy into functional and psychosocial hierarchies.

The implication matrix was used to bridge the gaps in the qualitative and quantitative data; that is, to determine the relationship among the quantified elements [17]. The column-items stand for means and the row-items stand for ends. There are two ways to construct an aggregated Implication Matrix. (1) Through summing up the number of direct and indirect relations between all the pairs mentioned by subject; (2) Applying five-point scale questionnaire that asks the respondents to score the associations between two elements.

The development of a HVM was to graphically represent the analytical results of the implication matrix. Depicting all the element relationships within the matrix onto

the HVM would be excessively complicated and the significant chains would be vague; thus, a HMV formulated using an aggregation approach must meet the following two criteria [18]: (1) elements that are included in the HVM must be proposed by 1/3 of the participants; and (2) the relationship of the direct link between two elements must be proposed by 1/4 of the participants. Subsequently, if a 5-point scale was used to measure the implication matrix data, the correlation between two elements are significant when the mean value of the two elements is greater than 3.60 [19].

2.3 Mind Mapping

Mind mapping is a structured radial mode of thinking that organizes messages based on hierarchies and categories [20]. The appearance and contours of a mind map comprises a core topic with many associations extending outward from the core topic. Each extending association formulates its own center point where sub-associations are subsequently generated and extended. Mind mapping is a visualized technique that presents the mental knowledge, ideas, concepts, and their mutual relations of an individual across a 2D plane [21]. Using mind mapping to generate ideas is extremely effective and useful, and facilitates the connection of each idea to other ideas and concepts [22]. The application of mind mapping not only assists designers in reorganizing past views, but also initiates unlimited creative ideas. This consequently creates a novel thinking framework.

3 Systematic Empathic Design Model Construction

Empathic design highlights the application of field observations and in-depth interviews to identify the problems and demands that consumers are unable to clearly express. However, during actual operations, this survey method is time-consuming and necessitates the surveyor to possess comprehensive experience and professional competency. Therefore, this study proposes a progressive model to systematically assist designers in satisfying the specific demands of individual consumers in varying environments. This further facilitates designers in providing suitable customized products that are customer-oriented. The proposed systematic empathic design model uses the participant observation method and the laddering technique to identify consumer demands, the implication matrix and HVM to analyze and confirm these demands, and mind mapping to satisfy these demands.

3.1 Understanding Consumers' Demands

Participant observation physically allocates surveyors into the observation group, and is a method that allows for the direct interaction between surveyor and consumer to effectively observe activity from within the group. The procedures in which this method is executed comprise the following: (1) surveyors select observation targets based on theme, arrange the observation schedule, and formulate observation items; (2) after acquiring participants' consensus, surveyors physically enter the observation environment, in which they engage in interpersonal interaction and employ strategies;

(3) when interacting with participants, surveyors must demonstrate cautious, honest, and unbiased attitudes to establish and maintain positive interactive relationships; (4) when conducting observations and collecting data, surveyors must uphold the key principles of "unfocused" observations; (5) surveyors must track all consumers' interactions with a specific product, during a service, or in a space, subsequently outlining their usage behaviors; and (6) surveyors must summarize the underlying responsive phenomena of the descriptive event, presenting these data on a phenomenon card. Phenomenon cards are composed of a group of images taken by the surveyors compensated by a set of descriptive text. These cards are then used as intermediaries during the laddering interviews to facilitate the focus group in linking the significance of their subconscious hierarchy.

Subsequently, the laddering method was employed to infer and allocate the observed phenomena into the 4 hierarchies of the means-end chain (e.g., as shown in Fig. 1). The procedures for the laddering method are as follows: (1) a group of designers were placed to a focus group; this group was instructed to select phenomenon cards they perceived as important or interesting prior to interviews; (2) initially, to link "phenomena" to "attributes," the question, "What is needed to improve it?" was asked; (3) then, the question, "Why is this important to you?" was asked; (4) content analysis was used to categorize the collected data into attributes, functional consequences, psychosocial consequences, and values hierarchies, simplifying, merging, and coding identical or similar significances; (5) Steps (1) to (4) were repeated and the next focus group was interviewed until no additional elements were added by the focus groups; consequently, this denoted that the elements have achieved representation. From the most physical phenomena to the most abstract values, this process facilitates consumer data to be more coherent and to demonstrate clearer causal relationships. In addition, the process of this stage facilitates interviewers to infer underlying cognitive structures that could not be observed.

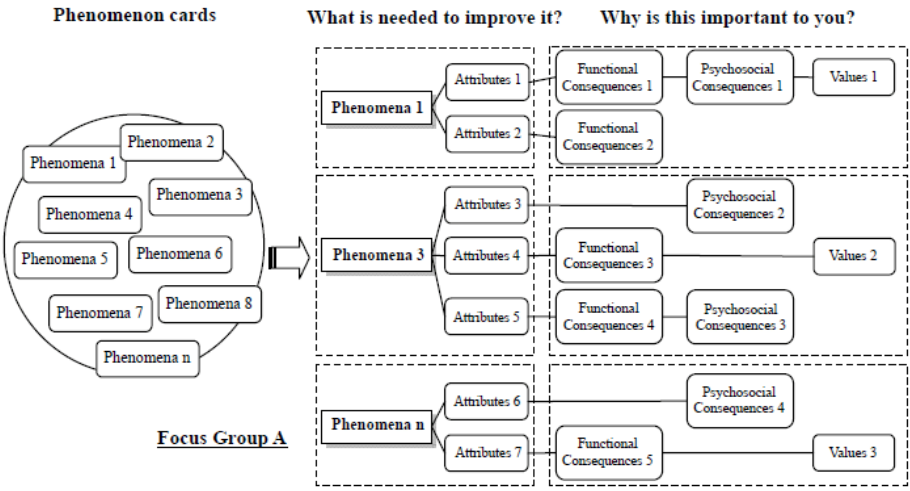

Fig. 1. Observing the phenomena → Laddering the cognition

3.2 Analyzing and Determining Consumers' Needs

Following the categorization and encoding of all the elements provided by the focus groups, the elements must then be converted into questionnaire form to allow target consumers to express the degree of relation between paired elements in different hierarchies. In this study, the 5-point scale was adopted as the scoring scale (e.g., as shown in Fig. 2). This type of implication matrix included weighted concepts that not only demonstrated relation and the differences in agreement levels, but could accurately reflect consumers' viewpoints.

Moreover, the data proved by the target consumer group was used to establish a summarized implication matrix. For example, the equation to calculate the association weight of each unit in the AF implication matrix was as follows:

$$\overline{A_i F_j} = \frac{\sum_{(i,j)=(1,1)}^{(24,13)} A_i F_j}{N} \tag{1}$$

where i is the number of attributes, ranging from 1 to 24; j the number of functional consequences, ranging from 1 to 13; N the number of consumers.

The A-F-P-V implication matrix can be converted into an HVM image, which can be used as a reference during the collective discussions of design teams. Based on the method proposed by Nielsen (1993), chains with mean values greater than 3.60 were illustrated. The thickness of the connecting lines represents the degree of relation between the paired elements (Fig. 3).

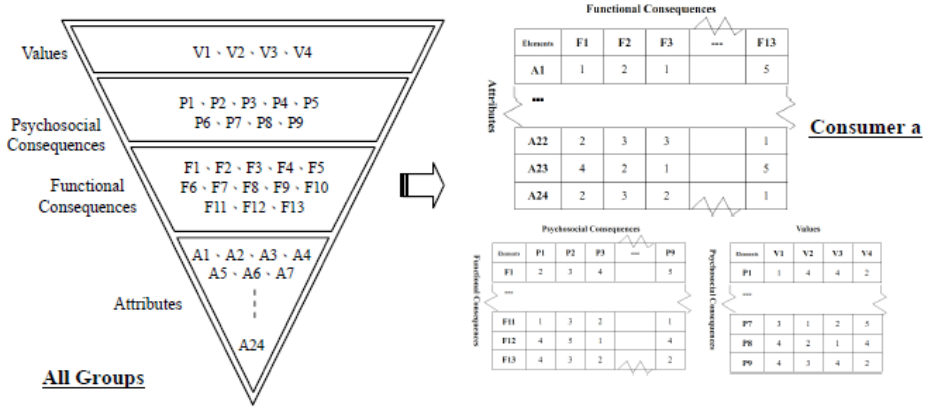

Fig. 2. Laddering the cognition → Implicating the matrix

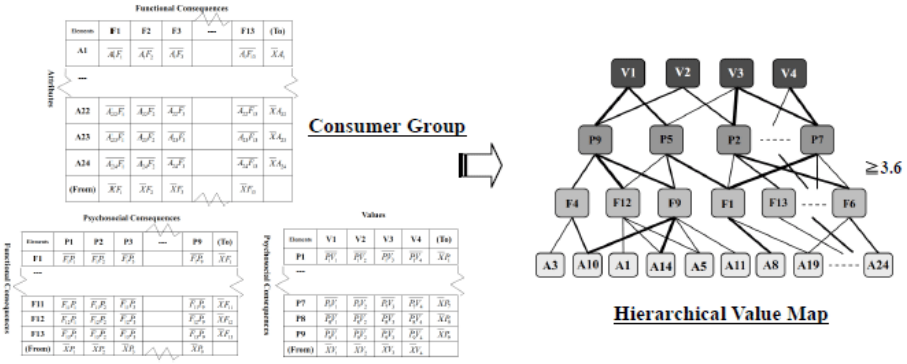

Fig. 3. Implicating the matrix → Hierarchy of the AFPV

3.3 Satisfying Consumers' Needs

Using HVM as the guidelines for product design is still overly complex. The From and To values of the various elements can be summed to further determine the strength of each complete chain and identify the several key chains for a simplified HVM. In Fig. 3, $\overline{X}A_i$ denotes the means-association rating of attribute *i*, and can be calculated using the following equation:

$$\overline{X}A_i = \frac{\sum_{j=1}^{13} \overline{A_i F_j}}{n} \tag{2}$$

where *i* is the number of attributes, ranging from 1 to 24; *j* the number of functional consequences, ranging from 1 to 13; *n* the total number of functional consequences, with the value of 13.

For example, for the chain A1→F12→P9→V1, the strength of this chain is:

$$[0+\overline{X}A_1(\text{To})]+[\overline{X}F_{12}(\text{From})+\overline{X}F_{12}(\text{To})]+[\overline{X}P_9(\text{From})+\overline{X}P_9(\text{To})]+[\overline{X}V_1(\text{From})+0]$$

Designers can predominantly consider the stronger chains. Subsequently, after confirming design guidelines based on the streamlined HVM, mind mapping can be employed to develop the conceptual prototype of the product (Fig. 4). During the formulation of the mind map, several important basic skills are required [23, 24], specifically, (1) the theme must be presented in text or as an image in the center of the page; the core ideas are extended from this theme; these core ideas are the "consequences" and "values" hierarchies in the streamlined HVM; (2) associations are free and uncritical; (3) each supporting idea extending from the core idea should only illustrate 1 key image or keyword; the first supporting hierarchy extends possible products and service; the second supporting hierarchy extends the provided function or effect; (4) all supporting ideas must form a node structure; the line thickness for core and supporting ideas must vary; (5) during thinking gaps, several blank links can be added from a keyword (or an image) to stimulate thinking; (6) brain flow and brain bloom can be applied as the thinking methods; and (7) symbols, color, or images can

be added to key opinions. The majority of investigatory research highlights the physical functions of products or services, and the immediate psychological satisfaction that these functions have on consumers; however, these studies neglected to examine the empathic benefits that these products or services provide, consequently failing to grasp the implicit opinions, experiences, feelings, and underlying context of the consumers. Thus, designers must focus on the "consequences" and "values" hierarchies when engaging in innovative product design.

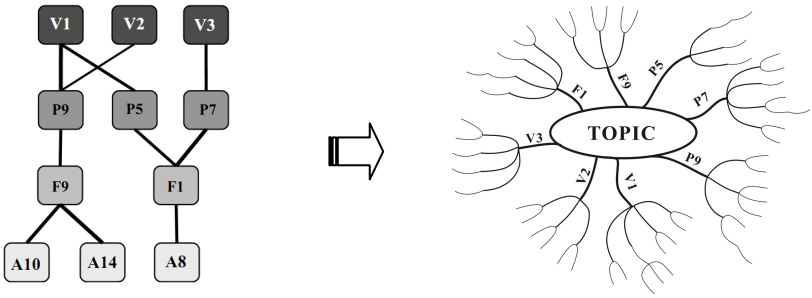

Fig. 4. Hierarchy of the AFPV → Developing the concept prototype

4 Conclusion

In a time where consumers are demonstrating greater self-awareness, customization has inevitably become a key challenge for product designers. In this study, the proposed systematic empathic design model initially conducted a series of planned observations and monitoring on individual consumers using participant observation to obtain underlying consumer phenomena. Subsequently, the laddering method was employed to interview focus groups. These interviews facilitated interviewers to identify the implicit A-F-P-V linking network behind these phenomena. The implication matrix was used to conduct demand analysis by providing consumers with a scaled questionnaire. The consumers used this questionnaire to express their opinions on the relationship level of paired elements. The HVM was used to highlight and confirm the consumer market. The crucial customization demands obtained through the HVM facilitates designers in formulating design guidelines. Finally, mind mapping assists designers in developing a conceptual prototype of the product that is capable of satisfying consumers. In the systematic empathic design model, consumers play an extremely crucial role. They facilitate designers in developing customized products based on actual market needs. The primary value of the proposed model is as follows: (1) Clear definitions and connections are provided between each procedure. This not only allows consumers to effectively participate in product design, but also shortens the design process. (2) The phenomenon-attribute-functional consequence-psychosocial consequence-value connection process effectively guides and stratifies

consumer demands, and facilitates designers in their idea formulation stages to implement customization. (3) Mind mapping assists designers in maintaining a balance between logical and imaginary thinking during conceptual design. This stimulates the designers to exert their full potential. In summary, the purpose of this study is to primarily introduce the systematic empathic design model, and the ways in which it effectively facilitates designers in satisfying the product demands of target consumers. Through the execution of this model, enterprises can more easily and rapidly adjust their product design orientation during market changes, and simultaneously take into account the key opinions provided by main consumers. Thus, the goal of this model is to ensure that designers not only focus on product functions and characteristics, but also provide consumers with a higher level of satisfaction, expediting consequences and values hierarchies of consumer behaviors.

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