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Application of analytic network process and two-dimensional matrix evaluating decision for design strategy

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ABSTRACT

With the intense competition of global market and the rapid technological advancement, the new product development becomes increasingly complicated, and relatively, designers face massive information that requires further integration. Design managers need an effective mechanism to understand the influence of design strategy application. Therefore, this study aims to use Analytic Network Process (ANP) and a two-dimensional matrix as the analysis tools, and discusses the usage situation and effect of design strategy, according to conformance quality and design quality. It also proposes improvement directions for design strategies. Based on the ANP results show that the order of top three items in design strategy are strengthening of market information collection and response capability (0.139), improvement of product quality level (0.135), and easy fabrication and maintenance (0.112). In addition, the ANP and the two-dimensional matrix model verified the use effect and improvement direction of design strategy. The ten design strategies can be classified into matured strategy, longitudinal improvement strategy, lateral improvement strategy, and two-way improvement strategy. The findings of this study can be provided to managers for reference in design strategy improvement.

1. Introduction

Design strategy refers to, a set of specific guidelines for design activities, which are proposed by enterprises based on an evaluation of the environment of specific products before the design activity, in order to ensure a successful design (Liu, 2011). Design strategy is taken by enterprises as a method to realize the goal of product innovation (Hsu, 2012). During planning, it is very important to select a design strategy. According to Brooke, Berridge, and Quy (1991), using the correct strategy will enable designers to be one link in the overall procedure of seeking the goal of satisfied customers. However, Hsu (2011) point out that although enterprises have new strategies and actions in product design innovation, the matching of product design and marketing in enterprises is limited. Because of design strategy is used to denote the effective allocation and arrangement of resources and to accomplish the goals of the company (Olson, 1994). Therefore, the selection of design strategy has to be considered its influence between enterprise marketing and consumers' demands simultaneously. During planning, it is very important to select a design strategy. Evaluating the decision of design strategy will help to reduce the risk of design activities. Through research and evaluation of planning concepts and related technical rules, as well as other considerations, goals can be achieved; moreover, the final goal can be realized through continuous mutual feedback.

Regarding the use of design strategy, Walsh, Roy, Bruce, and Potter (1992) pointed out that design is not to adopt a single type of strategy, but to show the concept of interactive use. For this, design managers must consider the various strategies influencing the design result of the design strategy, as well as the interdependence relationship between strategies. Analytic Network Process (ANP) can be applied in the importance analysis of related indicators, and can be taken as the basis for decision analysis or resource distribution (Abdi & Labib, 2011; Chen, 2014; Karpak & Topcu, 2010; Lee, Kim, & Park, 2010; Pak, Yeo, Oh, & Yang, 2015; Tseng, Chiang, & Lan, 2009). As in many actual decision problems, the internal factors between different levels have interdependence, and there is a feedback relationship between the factors at high and low levels (Saaty, 1996; Sarkis, 2003). Satty put forward ANP in 1996; according to this method, the feedback relationship is included the overall problem system, thus, decision results will be more accurate (Lee & Kim, 2001; Sarkis, 1998). However, most researches of the scheme selection problem are unable to reflect the interdependence relationship between the schemes and the factors of the schemes (Weber, Werners, & Zimmerman, 1990).

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Interdependence is classified into three types, as based on features, namely, (1) interdependence in technology, (2) interdependence in resources, and (3) interdependence in benefits (Czajkowski & Jones, 1986; Weber et al., 1990). If these actually existing features are cautiously considered, the enterprises will enjoy considerable cost reductions, and obtain bigger profits.

Furthermore, according to the research of Jayaram and Narasimhan (2007) when discussing the relationship between quality, cost, time-to-market, and success of a product design project, quality is classified into two types: (1) conformance quality, which refers to the degree of product satisfaction with design and operation specifications; and (2) design quality, which is the part that customers can see and perceive, including technological achievement, type, and conformance to the target customers' hobbies. Therefore, it is clear that, regarding the use of a design strategy, it is required to reach a win–win result between an enterprises' new product development performance (conformance quality) and consumers' demands (design quality).

In addition, H. Igor Ansoff, the founder of strategy management, put forward the Ansoff Matrix in 1957 (Ansoff & McDonnell, 1988). The Ansoff Matrix is a two-dimensional matrix with four divided quadrants, which uses products as the horizontal axis and markets as the vertical axis, in order to discuss the relationship between the market and the product strategy of an enterprise. In this paper, a two-dimensional matrix with four divided quadrants is adopted, with conformance quality as the horizontal axis and design quality as the vertical axis, in order to discuss the relationship of product design strategy use between enterprises and customers.

Due to the importance of design strategies when we make the decision, this paper tried to provide the analysis model for the designer or manager and it discusses the evaluation of decision strategy. This paper analyzes and evaluates the design strategy with ANP and a two-dimensional matrix, and develops analysis and discussion based on two major axial directions, namely, the enterprises' new product development performance (conformance quality) and the consumers' need for new products (design quality). In this paper we used the air conditioner development as the research subject. The proposed analyzes and evaluates model can be easily to help designers or managers to evaluate and select their strategy.

2. Literature review

2.1. Design strategy

Design strategy is used by a design team (Kasten, 1996). Through product design, a design team may gain competitive advantages (Kasten, 1996), as well as efficient distribution and coordination of design resources and actions, in order to complete the company goal (Hsu, 2012; Olson, Cooper, & Slater, 1998). In terms of research on design strategy, Keeley (1992) put forward a strategic palette with a successful case: in such palette, there are 12 strategy factors, and proper factors may be determined to constitute a design strategy according to different conditions. On the basis of reference to the research of Keeley (1992), Sung and You (1999) summarized the 10 design strategies applicable to the information industry of Taiwan (Hsu, 2013). Through analysis of strategic views given by design experts, Teng (2000) concluded 13 design strategies, which have been applied in the company's total product or single product in a diversified manner. According to the result of interviewing to Taiwan's household electrical appliance enterprises, Hsu and Chang(2004) analyzed and integrated 20 strategies related to household appliances design, and pointed out the relationship of association existing between the use of design strategy and company scale (Hsu, 2006). Based on the above statement of various strategies, product design strategy may be composed of a series of decision-related design strategies aimed at achieving the design goal through design strategy implementation. In this paper, with air conditioner development as the object, 10 design strategies applied by a company, as based on the research of Hsu and Chang (2004), are used for evaluation and analysis, and shows the relationship of interdependence between the strategies. These 10 design strategies include, DS1 (i.e. reduction of product production cost), DS2 (i.e. easy fabrication and maintenance), DS3 (i.e. conformance to specifications and standards), DS4 (i.e. improvement of product quality level), DS5 (i.e. improvement of design development process), DS6 (i.e. development of unique product function), DS7 (i.e. development of unique product form), DS8 (i.e. promotion of corporate product design image), DS9 (i.e. improvement of corporate brand image), and DS10 (i.e. strengthening of market information collection and response capability). Ten strategies as follows:

DS1. Reduction of product production cost: Under the premise of ensuring quality, we can reduce the cost through saving manufacturing costs and materials.
DS2. Easy fabrication and maintenance: We can improve the craft process and the method of operation.
DS3. Conformance to specifications and standards: The design products have to conform to all safety requirements and standards.
DS4. Improvement of product quality level: We can further improve and enhance product quality, and reduce the loss and the waste of products.
DS5. Improvement of design development process: We can improve production technology, product design and raise the utilization of materials and equipment.
DS6. Development of unique product function: We designed the unique function of the product.
DS7. Development of unique product form: We designed the unique form of the product.
DS8. Promotion of corporate product design image: We designed the product which has a good brand reputation, and to maintain an enduring brand.
DS9. Improvement of corporate brand image: We designed a unique brand image to attract consumers' attention and acceptance.
DS10. Strengthening of market information collection and response capability: In order to reduce the thread and the impact of potential competitors, we need to strengthen the ability on the collecting information from the market and the response capability.

2.2. Design quality: The consumers' need for new products

As consumers have improved independent consciousness, their demands have an expanded degree of divergence, and the market is developing towards heterogenization. It is held by enterprises that, consumers' individual needs can be satisfied through product development based on user-oriented designs (Bruseberg & McDonagh-Philp, 2002; Thomke & Hippel, 2002). The demand condition is the product attribute description by consumers, and can reflect consumers' real voice in the market, which is very important for enterprises to survive (Shen, Tan, & Xie, 2000). The designers, through knowledge collection, confirmation, distribution, storage, and reuse, may provide decisions or problem solutions, and is an important sector in expert functions (Liao & Chen, 2004). Therefore, the products designed with the participation of current trends and customer information can meet consumers' expectations and needs through the concrete feedback of customers (Yang & Yu, 2002). According to Lu, Liu, Jiang, and Lv