ISSN 2218-399X International Journal of *Kansei* Information, Vol. 2, No. 2, (2011) 61-70

Kansei Product Design for New Product Development- Duo-theme DEMATEL Approach

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ABSTRACT

Kansei product design (KPD) has become essential to a new product development (NPD) because more and more people nowadays are clinging to Kansai products—the aesthetic products that best fit the customers' affective needs with both mental and emotional satisfaction. This paper employs the duo-theme decision making trial and evaluation laboratory (DEMATEL) approach to conduct a positioning analysis for the core concept of KPD. An example of Kansei shoulder bag is illustrated. The results indicate that "Pride" and "Love" are the root causes to invite the customer's affective emotions, whereas "Sadness" and "Fear" are the root causes to distress the customer's affective emotions. Accordingly, making the customer feel pride and love should be built in the Kansei shoulder bag design. Meanwhile, making the customer feel sad and fear should be eliminated from the Kansai shoulder bag design. Based on the findings, some implications and suggestions are discussed.

Keywords*: *Kansei product design (KPD), new product development (NPD), aesthetics, duo-theme DEMATEl

1. Introduction

Functionality, quality, and usability are no longer the main concerns of consumers' choice for products nowadays. More and more people are clinging to Kansai products-the aesthetic products that can best fit their affective needs by touching their hearts or moving their emotions. The word "Kansei" is a Japanese terminology for aesthetics. Schutte et al. [1] remarked that Kansei is the impression that somebody gets from a certain artifact, environment or situation using all the senses of sight, hearing, smell, taste, as well as cognition; and subsequently, a complex mind pattern is built up and stored in the brain, containing all the impressions experienced and, thereby, building the foundation for human behavior. According to recent literature, an increasing number of consumers are looking for the products in marketplace, especially the new products, based on product's Kansei appeal for the following several reasons.

First, traditional product attributes have become so homogeneous that these attributes can hardly discriminate the products. Schutte et al. [1] indicated that today's customers have difficulties to distinguish between many products due to the functional equivalency, and therefore they make their purchasing decisions based on more subjective factors such as the Kansei or aesthetics. Reimann et al. [2] also remarked that the core product attributes, such as quality and functionality, have become increasingly homogeneous in marketplace.

Second, beyond basic needs, customers' affective needs also require paying more attentions. Jiao et al. [3] emphasized that the functional and affective needs have been recognized to be of major importance for customer satisfaction; however, functional design and ergonomic design no longer empower a competitive edge; and the only determinant is to match customers' affective needs. Reimann et al. [2] also indicated that designing and marketing aesthetic products is of growing importance in markets where many basic needs of consumers have been satisfied.

Third, a consumer's emotional response can be induced by the physical appearance of a product. As pointed out by Chen and Chang [4], the aesthetic appeal of a product is a key consideration in today's consumer marketplace because the consumer decision to purchase a particular product is greatly motivated by the emotional response induced by its physical appearance.

Last but not least, Kansei is the key point to touch a consumer's heart. Hsiao and Chen [5] noted that product should be not only safe and efficient, but also pleasurable to use, thus satisfying the customers' needs becomes a critical task. Jiao et al. [3] remarked that an affective design of a product should incorporate customer's affective needs into

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Received: May 28, 2011
Accepted: Recommend from
2011 Kansei Conference, May, 2011

the design elements so as to affect customer's affective satisfaction. Reimann et al. [2] also indicated that firms are shifting their differentiation efforts away from concrete product characteristics towards less tangible features such as aesthetics.

In sum, kansei product design has become essential to the new product development (NPD). Only possessed with Kansei can a product, especially the NPD, win the customers' buy-in with both mental and emotional satisfaction. In literature, the Seven Product Planning Tools (P7) and Kansei Engineering (KE) are perhaps the most known two powerful and sensible methodologies for planning the hit products. In practice, it is vital to settle the core concept for NPD and to conduct a position analysis for identifying the core concept of a product. P7 performs positioning analysis through interview survey and questionnaire survey, and the core concept of a product is then generated based on the results of factor analysis. As for KE, it conducts questionnaire survey and expert interview as well as creative techniques in order to find out the zero-level concept as the core concept of a product. These two methodologies share the same pitfalls as follows. First, they are not really to address the customization and personalization, especially for the case of satisfying the Very Important Person (VIP). Second, they require a lengthy procedure with heavy analytical tasks. Third, they rely on statistical analysis with rigorous underlying assumptions. They cannot allow the core concept to divide into two opposite themes such as satisfaction vs. dissatisfaction for better decision-making by incorporating the satisfaction elements and meanwhile by avoiding dissatisfaction elements into the core concept for NPD. To fill up these gaps, this paper proposes a duo-theme decision making trial and evaluation laboratory (DEMATEL) for positioning analysis of core concept for Kansei product development.

The rest of this paper is organized as follows. In section 2, the NPD, P7 and KE related literature is reviewed and the concept of Kansei product design (KPD) is discussed. In section 3, the proposed methodology is introduced. In section 4, an example of Kansei shoulder bag design is demonstrated. Some implications are discussed in section 5. Finally, conclusions and suggestions for future studies are addressed.

2. Literature Review

2.1 New Product Development

New product development is similar to new product planning (NPP) in that both are in effect a process involved in creating new products. However, NPD has a broader view than NPP; thus, NPD is the term used to describe the complete process of bringing a new product to market. It includes generating and commercializing new products with activities ranging from market research, marketing strategy (segmenting, targeting and positioning), idea generation, product design, detail engineering, to marketing interventions. The complete process of NPD can be divided into two stages—pre-NPD and post-NPD. The pre-NPD stage highlights a series of activities such as concept development and testing, business analysis, beta testing and market testing, as well as technical implementation; while the post-NPD stage emphasizes such activities as commercialization with marketing mix named as Four P's (product, price, place, and promotion).

Referring to KaKrkkaKinen et al. [6], NPD consists of two interacting processes—customer need assessment process and product development process, and these two processes also have interactions by strategic planning processes. More specially, Tzokas et al. [7] proposed six NPD stages, including idea generation, concept development (ingredients, materials, technologies for new product ideas), build business case (a thorough market, technical and financial analysis), product development (the design and manufacturing of prototypes), market testing, and market launch. They also suggested six evaluation gates, including idea screening, concept testing, business analysis, product testing, analyzing test for market result, and post-launch evaluation (short-term and long-term) during the development process. For these evaluation gates, five dimensions (market-based, financial-based, product-based, process-based, and intuition-based) and their evaluation criteria have also been suggested.

According to Tzokas et al. [7], we may consider that NPD includes six main phases, including idea generation and screening, concept development and testing, build business case and analysis, product development and testing, market testing and analysis, as well as market launch and evaluation, as depicted in Figure 1.

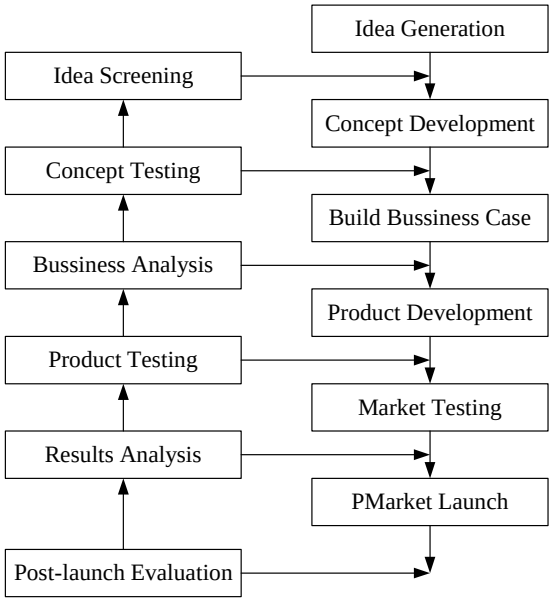

Figure 1 NPD process modified from Tzokas et al.

2.2 Seven Product Planning Tools (P7)

Kanda [8] published a pioneer popular book in Japanese entitled "Seven Product Planning Tools" which introduced seven tools for new product planningand hence known as P7 for NPP. These seven tools include group interview, questionnaire surveys, positioning analysis, concept checklist, table-type conceptualizing, conjoint analysis, and quality chart. Later on, Nagasawa [9] further addressed the issue of creating new products for satisfying the customer needs by systematizing the NPP process and combining the marketing with the originally developed QC methods. It was known as a revision of the P7, including interview survey, questionnaire survey, positioning analysis, conceptualization, evaluation and selection analysis, conjoint analysis, and quality tables. Indeed, the P7 is a set of well-developed methodology for NPP; especially, it specializes in some important parts of the pre-NPD stage that underscores such activities as idea generation and screening, concept development and testing, as well as product development and testing.

2.3 Kansei Engineering (KE)

It is indispensable for the consumer-oriented NPD to consider the consumers' Kansei—their emotional feelings and impressions about the products. Kansei Engineering, attempting to convert Kansei into product design, is a technology to transfer human perceptions, emotional feelings and mental images into a tangible (new) product, and it deals with a wide spectrum of disciplines ranging from ergonomics to psychology [10~12]. KE is imperative for product design because it assembles favorable Kansei elements into a product in order to attract consumers to purchase. It has become a useful methodology that may transform human imaginations and sensitivity into physically design elements in order to induce human feelings such as beautiful, comfortable, happy and passional about a product [13].

According to Nagamachi [12], NPD using KE method starts with the survey of customers' driving behavior in order to find out the zero-level concept that is further broken down into sub-concepts which are used to guide the development of physical feature, ergonomics experiment and engineering. Hence, KE can be viewed as a sort of NPD methodology, which is also a variant of P7 for NPP with the emphasis on Kansei. Referring to Kanda [8], Nagasawa [9], and Nagamachi [12], one can consider that the procedure of KE contains three main phases. The first phase is to set up the goal product and the targeted customer through market research and marketing strategy. The second phase is to build a hierarchical structure of Kansei words (excel in describing affective needs) through group interview and questionnaire survey about life style and purchasing behavior for targeted customers. The group interview with the Kawakita Jiro(KJ) method or Affinity diagram method is starting with determining a focus question/theme, card making, grouping and naming, and explanation. Through the KJ method that asks about usage reasons/patterns, user dissatisfaction as well as wishes, then ideas can be well grouped and named in order to develop the questionnaire, together with discovering the core concept that is unique phrase which denotes the zero-level concept topped in the hierarchical structure. After questionnaire survey with factor analysis, raw ideas are transformed into fewer validated constructs (1^{st}-level concepts) including measuring items (2^{nd}-level concepts). In the third phase, according to the 2^{nd}-level concepts, the appropriate physical features (e.g., size, width, and height) can be addressed, and accordingly the ergonomics experiments as well as required engineering are conducted. In addition, according to the result from the third phase, the 3^{rd}-level concepts can be further developed; usually conjoint analysis is utilized here to obtain a portfolio of attribute values for conduct the NPD.

Additionally, several Kansei research have employed other approaches. For example, Lee et al. [14] utilized the following steps to address the

design issue of high heels in female consumer market, such as using 5W1H to find out 31 items that are product features or purchase factors; employing Interpretive Structural Modelling (ISM) to analyze the 31 items in order to obtain consumer's purchase decision paths; using Grey System Analysis (GRA) to make weightings for the elements within the selected purchase decision path; and using Quality function deployment (QFD) to convert the elements (as the design principle) into requirements of product structure. Guan et al. [15] proposed a simpler approach as follows: determining a set of emotional words through literature review or expert interview; designing and developing prototypes; asking targeted customers to evaluate the prototypes about usability or aesthetics; and so on.

2.4 Kansei Product Design

The esthetic information of product form is imperative to NPD, including such variables as product shape, color, or material relating to consumers' psychological preferences [16]. Hsiao et al. [17] noted that customers usually obtain their first impression of a product from visual stimuli (e.g., form, color, and material); and if these three stimuli are well coordinated, the product is more greatly appreciated. Moreover, Chen and Chang [4] remarked that the product form plays an essential role in determining the commercial success of a product, because a consumer's psychological perception of a product is significantly influenced by its aesthetics.

Many studies have addressed the issue about product form. For example, Hsiao and Chen [5] indicated that one of the designers' important tasks is to evoke specific affective responses via the manipulation of product shapes; they proposed a common framework, based on four fundamental dimensions (trend factor, emotion factor, complexity factor and potency factor), which examines specific affective responses to product shapes in order to manipulate particular shape features leading to better designed products. Chang [16] examined factors influencing visual comfort appreciation of the product form of digital cameras; the results of product esthetics for digital camera design showed that a product is deemed to have high visual comfort due to its simple and compact images, and that the overall evaluation of visual comfort depends on such determinants including hi-tech style, unity, simplicity, quality texture, and a proper proportion. Chen and Chang [4] utilized a numerical definition-based systematic approach to extract the product form features which are critical to determine the consumers' perceptions of product image.

Understanding the link between emotional response and design is particularly important because of the critical role that emotions often play in consumers' decision making. Desmet [18] found that a product design can evoke 14 different types of emotions in consumers: desire, inspiration, admiration, amusement, satisfaction, fascination, pleasant surprise, disgust, indignation, contempt, unpleasant surprise, dissatisfaction, disappointment, and boredom. Kumar and Garg [19] pointed out seven aspects (balance, emphasis, movement, pattern, proportion, harmony, and variety) of aesthetic principles and examined the relationships between aesthetic principles and cognitive emotion appraisals. They indicated that harmony and typicality interact to affect appraisals of pleasantness and attentional activity. Deng et al. [20] examined aesthetic color combinations in a realistic product self-design task and indicated that people de-emphasize lightness and focus on hue and saturation. Venkatesh et al. [21] investigated how female consumers' attitudes and preferences relating to bodily appearance are linked to their perceptions of the aesthetics of fashion. Townsend and Shu [22] examined the influence of aesthetic design on consumer behavior involving financial products. Meyers-Levy and Zhu [23] examined the gender differences in the meanings the consumers infer from music and other aesthetic stimuli. Wang et al. [24] examined the relationships between aesthetics and the online shopping environment and indicated that consumers' cognitive, affective, and conative outcomes can be significantly evoked by aesthetic stimuli

3. Methodology

DEMATEL is designed to deal with important issues of world societies as a causal analysis technique for gaining causal knowledge [25,26]. It is a useful causal analysis technique for acquiring causal knowledge because it can visualize the structure of complicated causal relationships. The conventional DEMATEL approach [27~29] has been applied in various fields; however, it has some limitations [30]. The primary limitation is that it handles a set of multifaceted factors into one theme and displays only partial information; thus, it may mislead the decision-makings. In practice, some problems require considering two themes, such as "satisfied vs. dissatisfied" [31], "like vs. dislike", "agree vs. disagree", "pleasant emotion vs. unpleasant emotion" [18], "positive emotion vs. negative emotion" [32], and so on. An understanding

of the factors leading to favourable answers is as important as an exploration of the factors causing non-favourable responses, particularly for the NPD.

For the purpose of dealing with the two-themed issues, Wu et al. [30] have recently proposed a duo-theme DEMATEL that can acquire causal knowledge in two distinct themes and obtain an incorporated causal map, from which more information can be visually detected; thus, the decision makers can easily spotlight on the root causes to develop effective actions. The procedure of the duo-theme DEMATEL embraces three main steps: (1) selecting two sets of criteria to represent the duo-themed problem; (2) using the DEMATEL to respectively conduct the cause-effect analyses through creating the initial direct-relation matrices, normalizing the initial direct-relation matrices, and completing the total-relation matrices for two themes; and (3) building an integrated matrix—a four-quadrant causal map.

The rationale is briefly explained as follows. Let vector D and vector R respectively denote the sum of rows and the sum of columns from the total-relation matrix. The horizontal axis (D+R), named Prominence, reveals how much importance the factor has; the vertical axis (D-R), named Relation, divides factors into a cause group and an effect group. The factor belongs to cause group if (D-R) is positive, whereas it belongs to effect group if (D-R) is negative. However, there is a primary difference between the duo-theme DEMATEL [30] and the conventional DEMATEL. The duo-theme DEMATEL intends to combine two causal maps into the duo-theme matrix, as shown in Figure 2.

The value of (D+R) of each factor of the negative-theme (perceived risks) requires transforming positive into negative such that the cause-effect factors of the negative-theme are located in Quadrant II and Quadrant III, and that the cause-effect factors of the positive-theme (perceived benefits) are positioned in Quadrant I and Quadrant IV. To make better decisions, one should specially focus on two categories of factors—the root causes in Quadrant II and Quadrant I.

4. An Example

Suppose that we wish to design a Kansei shoulder bag for a VIP lady. First of all, we need to conduct positioning analysis of the core concept for the shoulder bag. Referring to Laros and Steenkamp (2005), this study considers a hierarchy of consumer emotion that consists of two dimensions: positive emotion (contentment, happiness, love, and pride) and negative emotion (anger, fear, sadness, and shame). According to the three-step procedure of the duo-theme DEMATEL, we adopt the hierarchy of consumer emotion and employ the duo-theme DEMATEL for use. As shown in Figure 3, the evaluation framework for consumer emotion is produced.

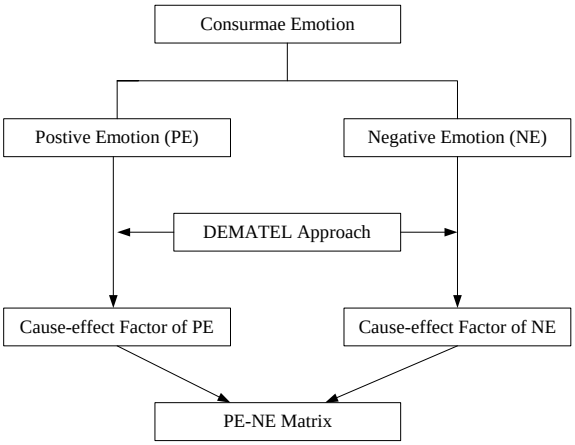

Figure 3 The evaluation framework for kansei product design

Then we use the DEMATEL to respectively conduct the cause-effect analyses. The lady can be asked to assess the above eight emotions, which are measured with the linguistic scale ranging from 0 (No influence), 1 (Very low influence), 2 (Low influence), 3 (High influence) to 4 (Very high influence). Tables 1 and Table 2 respectively show the initial direct-relation matrices for the positive emotion and for the negative emotion.

Table 1 The initial direct-relation matrix for positive emotion

	Contentment	Happiness	Love	Pride
Contentment	0	2	2	1
Happiness	3	0	1	2
Love	2	2	0	2
Pride	3	2	2	0

Table 2 The initial direct-relation matrix for negative emotion

	Anger	Fear	Sadness	Shame
Anger	0	1	1	2
Fear	2	0	2	2
Sadness	3	3	0	3
Shame	1	1	1	0

Finally, the resulted PE-NE matrix is created as shown in Figure 4. Based on the resulted PE-NE matrix, we can clearly see that “Pride” is the foremost factor for the theme of positive emotion

while "Sadness" is the leading factor for the theme of negative emotion. The findings are critical for positioning the core concepts for Kansei shoulder bag design.

5. Discussion and Implications

Based on the above results, some implications are discussed. The resulted PE-NE matrix in Figure 4 has visually displayed the positive and negative key determinants respectively.

For the theme of PE, one can see that the cause group includes Pride and Love, while the effect group embraces Happiness and Contentment. It implies that to design a Kansei shoulder bag for a VIP lady, pride and love are the two foremost constructive concepts that would invite the customer's affective needs. As such, making the customer feel pride and love should be built in the Kansei shoulder bag design.

For the theme of NE, on the other hand, it is clear to see that the cause group includes Sadness and Fear, while the effect group embraces Anger and Shame. It implies that to design a Kansei shoulder bag, both feelings of sadness and fear are the most influential upset concepts that would distress the customer's affective needs. Therefore, these two negative causes should by all means be eliminated from the Kansai shoulder bag design.

In order to fit the customers' affective needs with both mental and emotional satisfaction, it requires conducting positioning analysis for the core concept of Kansei product design. Additionally, for ensuring the success of a NPD, it is suggested to further undertake a post-survey (discussing with the VIP lady) in order to unearth more profound information for use. The post-survey may include such questions as the reasons why she liked/disliked and the types of shoulder bags she liked/disliked in the past, at present, and in the future. It is because that past experience, present feeling, and future desire can dynamically interact to shape one's affective needs.

6. Conclusions

It is important to fit product specifications according to customers' affective needs, because customers purchase or use products to accomplish their mental and emotional satisfaction. Understanding and fulfilling customers' affective needs have been recognized as a massive challenge for companies across industries. Rather than offering mass customization products, which corresponds to an average satisfaction of several customer needs, a consumer's decision to purchase is deeply affected by the emotional response that stimulated by physical appearance of a product. This calls for effort of Kansei product design. This paper has successfully demonstrated with an example of design a customized shoulder bag by using the duo-theme DEMATEL approach. It has contributed to the Kansei literature in implementing the duo-theme DEMATEL to deal with positioning analysis of the core concept for Kansei product design products.

Some limitations are noticed in this study, which deserve further exploration. First, the study only conducted a numerical example. Application of the proposed operational procedures deserves further exploration with real case studies. Second, it is a good starting point of using the two dimensions (positive and negative) of consumer emotion to address the positioning analysis of core concept for Kansei product development. Other kinds of emotion dimensions, such as pleasant emotion and unpleasant emotion, are also worthy attempting. In the future research, the duo-theme DEMATEL can also be employed to examine visual stimuli (e.g., form, color, and material) for Kansei product development in terms of positioning analysis of the core concept. In doing so, a fruitful Kansei information system can be built for use. Based on the Kansei information system, more interesting Kansei analyses can be implemented with soft computing or data mining techniques (e.g., rough set theory, grey system theory, and artificial neural network).

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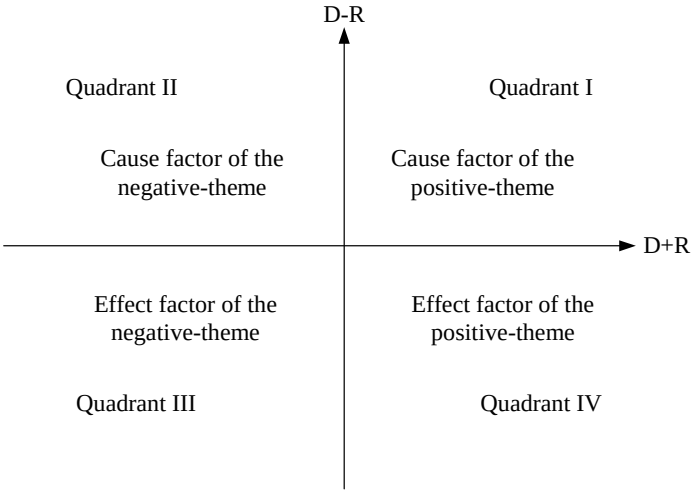

Figure 2 The causal map in duo-theme matrix

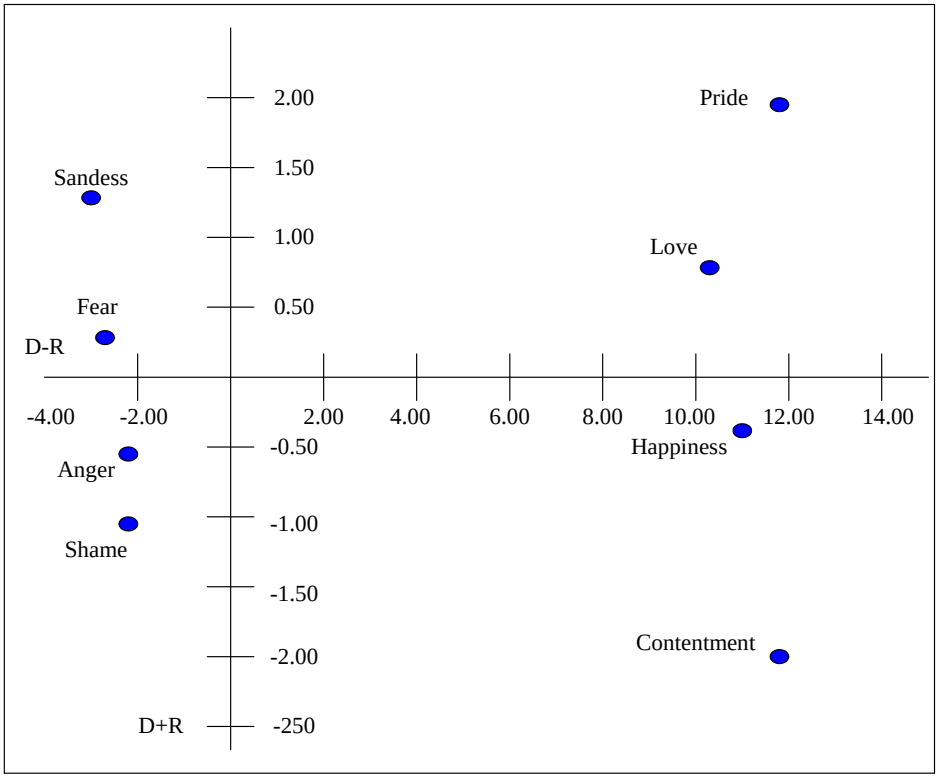

Figure 4 The resulted PE-NE matrix

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ISSN 2218-399X International Journal of *Kansei* Information, Vol. 2, No. 2, (2011) 61-70