# Application of Semantic Differential Technique and Statistical Approach to Evaluate Designer's and Consumer's Perception in Furniture Design

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***Abstract***

Furniture is one of the products that are always changed to meet customer's requirements. These requirements challenge the designer to develop a product that must satisfy the customer. Many furniture products are designed to satisfy the wide-ranging style of target customer group based on designer's experiences and preferences and the existing designs both from internal and external company. However, the designer does not know whether the product would satisfy the customer or not until it has been launched into the market. This study therefore applies Semantic Differential (SD) technique to investigate the customer's perception in furniture products. The main purpose of this study is to discover the differences in perception between consumer and designer in the modern and contemporary style of bed furniture products. The product samples are selected and evaluated by experienced designers and target group of customers. SD technique is applied to measure emotional content in where Kansei words (semantics) are used to describe perception of the selected products. The result of this study shows that SD technique is applicable to furniture design, and that the perception between the designers and the customers is different in certain aspects.

***Keywords****: Kansei Engineering, Semantic Differential Technique, Furniture, Design Attributes*

## 1 Introduction

Customer satisfaction is one of the key successes in most company. It goes deep into the business process right up to design stages of a product or service, rather than the points of delivery alone. The level of customer satisfaction achievement typically depends on how much importance that the organization attached to customer. Nowadays, consumers desire to match their own feelings with the products they wish to buy. Furniture is one of the most products that are developed based on the "market-in" philosophy [2, 3] or consumer-oriented strategy. By this strategy, the customer's needs and preferences are primary concerns in the product development. Many furniture companies are currently attempting to improve themselves from Original Equipment Manufacturer (OEM) to be Original Design Manufacturer (ODM) or even Original Brand Manufacturer (OBM). On the other hand, they usually design and develop products based on their experiences and preferences. Hence, the designer does not really know whether the product would satisfy the customer or not until it has been launched into the market. This study applies the Semantic Differential method to investigate the perception between designers and customers in modern and contemporary style of furniture products. The main purpose is to discover whether the designer's perception is different from the customer's. The other objective is to analyze which product samples are preferred by the designers and customers at different emotion.

## 2 Literatures Review

### 2.1 Kansei Engineering (KE)

KE is invented in the 1970s by Nagamachi [1] at Hiroshima University. Kansei is a Japanese term that is used to express one's impression towards artifact. Nagamachi [3] defines Kansei as a word that means customer's feeling and includes the customer's feeling about product design, size, color, mechanical function, feasibility of operation, and price as well. KE combines Kansei and the engineering realms to

assimilate human Kansei into product design with the target of producing that consumer will enjoy and be satisfied with [2, 3]. Kansei Engineering System (KES) can be defined as a methodology for translating human psychological such as feeling, emotion and needs related to product design elements, as shown in Figure 1, in order to decide which aspects of the product would elicit responds from the customer at an emotional level. Consequently, products can be designed to bring forward the intended feeling.

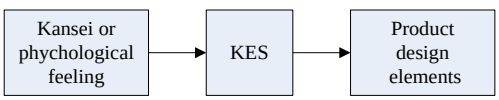


**Figure 1**: A diagram of a process of KES [2]

KE is regularly adopted in the early stage of the product development in product research so that sufficient changes can be brought into the product to accommodate the preferences of the customer. The focus of KE is to identify the Kansei values of products that trigger and mediate emotional response. In the KE, the mapping process between the customer domain and the product domain is driven by semantics and design attributes. The KE process implements different techniques to link product emotions with product properties. There are six techniques for the implementation of KE concept: Category Classification (Type I), KE computer System (Type II), KE Modeling (Type III), Hybrid KE system (Type IV), Virtual KE (Type V) and Collaborative KE (Type VI). These techniques differ from each other in their approaches to apply KE in different development process situations in terms of information availability, complexity, and required performance. The initial KE Type I uses some qualitative techniques while later techniques use more sophisticated quantitative and computer based methods [4]. This study applies KE Type I or Category Classification method. It breakdowns the Kansei category of a product into a tree structure in order to get the design details. Many researchers and industrial sections, particularly in automotive vehicle design, have applied this method to study product form, styles and other attributes in product design. For example, Mazda has succeeded in developing the new sports car named "Miyata" which is called "Eunos Roadster" in Japan and has been a good seller in the U.S. as well as in Japan. [2] KE Type I starts from decision of product strategy through the results of designer's sketch. Nagamachi [1, 2] breakdowns the procedures of KE Type I into ten steps as shown in Figure 2.

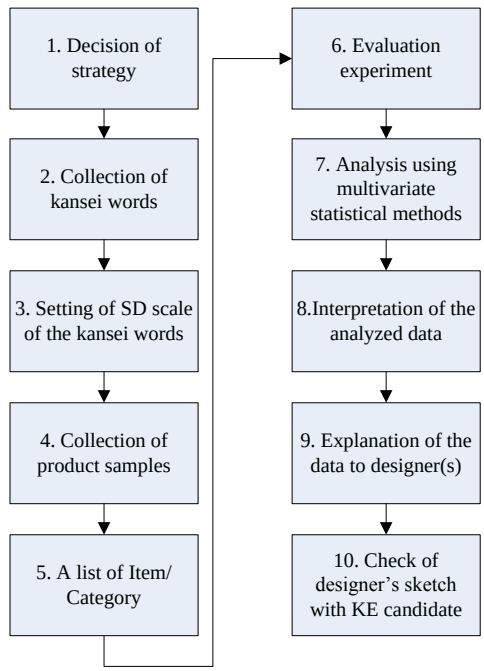


**Figure 2**: A flow of the KE Type 1 [1]

1. Company strategy

KE starts from the decision of a client company strategy. The company wishes to create a new product in a specific product field using KE. The company should have the specified concept or strategy for the new product.

2. Collection of Kansei words

The next step after decision of the new product is to collect the Kansei words related to product concept (20-30 Kansei words).

3. The collected Kansei words

Kansei words are arranged on a 5-point or 7-point SD scale. The 5-point scale is better for panel's work on easy evaluation.

4. Collection of other product samples

For comparison among the similar products from the company and other makers, samples are collected from the different companies including benchmark (about 10-20 samples).

5. A list of Item/Category

Item/Category implies the design specifications concerning collected sample products. All product properties are described, for instance color, shape, size, logo mark, etc.

6. Evaluation experiment

After employment of panels of male and female (students or adults), all subjects participate in the evaluation experiment. They record their feelings with Kansei words to each sample on the SD scale sheet.

7. Statistical Analysis

The evaluated data have analyzed by statistical methods, especially by the multivariate statistical analysis.

8. Interpretation of the analyzed data

All analyzed data should be interpreted from the viewpoint of Kansei Engineering. Our purpose is to find the relationship between human Kansei and product property. From the analyzed data we find the relations of each Kansei with design specifications.

9. The explanation of data

The data interpretation should be explained to the company designer(s) in order to make the new design with the help of the designer(s).

10. Collaboration with designer(s)

The KE motivates the company designer(s) to create the new emotional product design stepped up over the analyzed data. In this process, the Kansei Engineer should support the designer's creation based on the KE data. This is a kind of collaboration between the KE and the designer(s).

### 2.2 Semantic Differential (SD)

Osgood et al. [8] defined that Semantic differential (SD) is measurement instrument most commonly used to User-Centred Design (UCD) techniques to obtain the emotional value of product. SD has been applied in several product designs e.g. street furniture, office chairs, cars, fixed telephones, mobile phones, microelectronics, printers, table glasses or even in the design of mascots used in sports events [7]. To investigate the customer's perception of product, the semantic differential method (SD) is one of the most frequently used procedures. It measures people's reactions to stimulus words and concepts in terms of ratings on bipolar scales defined with contrasting adjectives at each end [6]. Many researches have used this method to study specific aspects of product form, including styles, color, and other attributes in product design.

## 3 Methodology

The study can be divided into 3 stages. The stage-1 is to collect and validate polar Kansei words that relative to the modern and contemporary style of bed furniture products. Stage-2 is to select product samples in modern and contemporary style from the product database. The stage-3 is to allow the customers to evaluate the product samples based on the design questionnaire and semantic differential technique. Accordingly, the responses from the customers are analyzed and summarized in the next section, as shown in Figure 3.

### 3.1 *Collect and validate Kansei words*

In this stage, a total of 130 Kansei words are collected from literature reviews, magazines and websites about furniture products. However, some of these Kansei words are unclear or ambiguous or have the same sense of meaning. The unclear or ambiguous words were omitted while the others were classified. The less significant words in each group were removed while the words, which are constantly repeated in describing the product elements, are retained. The best described words that are related to the contemporary and

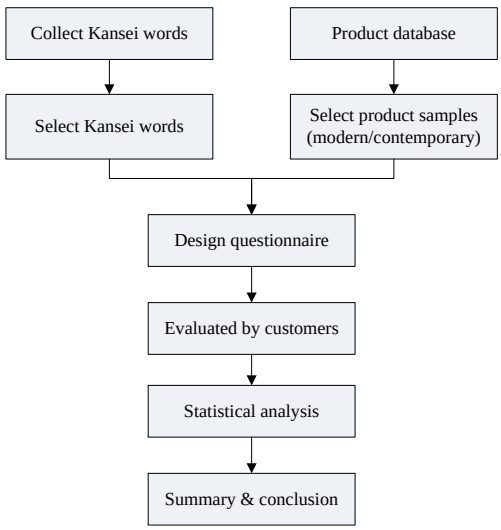


**Figure 3**: Research methodology of the study

modern style were selected from furniture designers, experts, and students in the relative fields (from 20 participants, 12 male and 8 female). Item-Objective Congruency Index (IOC) is applied to validate the responses of the investigation. Finally, 17 bipolar (Semantic Differential, SD) words are discovered from the collected Kansei words, as shown in Table 1.

**Table 1**: SD words used in the pilot test

| | |
|---|---|
| Ugly – Beautiful | Decorative – Minimalist |
| Classic – Trendy | Artificial – Natural |
| Dirty – Clean | Old – New |
| Uncomfortable – Comfortable | Outstanding – Anonymous |
| Individual – Common | Luxury – Plain |
| Coarse – Delicate | Non-geometric – Geometric |
| Flat – Glossy | Complex – Simple |
| Active – Inert | Cold – Warm |
| Informal – Formal | |

### 3.2 *Select product samples*

The product samples were selected from the product database of a case study company. Initially, the 23 bed samples were selected by the design team, with experiences more than three years in furniture design, of the case study company in regard to the modern and contemporary style. In addition, price is the other criterion that is taken into account to consider the selection. Price usually means the level of affordability of buyers and allows the company to set the target group of customers. This study focuses on the bed samples with average level of price that is the wide-range target group of the company. With regard to the criterion above, the design team finally selected 8 bed samples which have clear perception in modern and contemporary style as shown in Figure 4.


**Figure 4**: Product samples used in the test

### 3.3 *Investigation and evaluation*

This study investigated 40 customers, who are the new generation consumers in working age between 25-30 years old, having average-good salary, and are looking for furniture for the accommodation. The validated bipolar Kansei words are set as referenced parameter $S_i$ for the $i^{th}$ pair of positive adjective at the right-hand and negative (antonym) adjective at the left-hand. The range of each $S_i$ is set from -2 to +2, where the +2 means the maximum value for the positive semantic while the -2 means the maximum value for the negative semantic as shown in Figure 5.

| Kansei words | Scale value | | | | | Kansei words | Product sample |
|---|---|---|---|---|---|---|---|
| | 2 | 1 | 0 | 1 | 2 | | |
| Ugly | | | | | | Beautiful |  |
| Dirty | | | | | | Clean | |
| Uncomfortable | | | | | | Comfortable | |
| Individual | | | | | | Common | |
| Coarse | | | | | | Delicate | |
| Flat | | | | | | Glossy | |

**Figure 5**: A part of the questionnaire used in the investigation

## 4 Results and discussion

### 4.1 *Results of the investigation*

According to the investigation, Figure 6 shows the comparison of average mean values of the 8 bed samples of all the semantics between the perception of designer and customer. An analysis of the results shows that all the selected bed samples are generally positive perceived (16out of the 17 SD words for the designers, 12 out of the 17 SD words for the customers). It means that both the designers and the customers rate almost semantics in positive. For the overall average mean, both the designers and the customers agree that the best-value semantic is Clean whereas the worst-value semantic is Non-geometric.

Figure 7 shows further the comparison of mean values of all the semantics for each product sample in perception between the designers and the customers.

This study uses a statistical approach, non-Parametric Kruskal-Wallis test, in order to test the difference in perception between designer and customer (profile) in each semantic. The result shows that there are 10 semantics indicating the difference at the significant level (α) whereas the semantics: Beautiful, Trendy, Clean, Comfortable, Common, Glossy and New– are not different in their perception, as shown in Table 2.

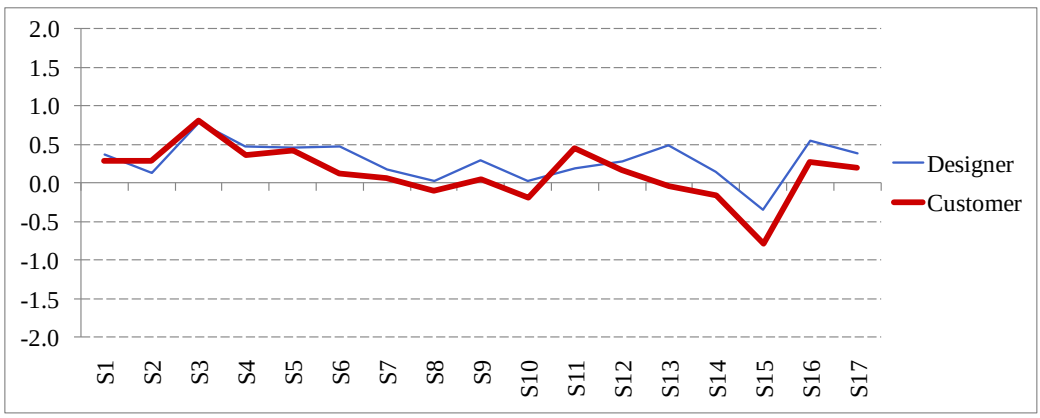


**Figure 6**: Comparison of average mean values between the perception of designer and customer


**Figure 7**: Comparison of mean values between the perception of designer (thin line) and customer (thick line) for each SD word

The non-Parametric Kruskal-Wallis test also shows that there are statistically significant differences in the perception among the products in almost all the semantics at the significant level (α), except the semantics S7 (Flat–Glossy), S8 (Active–Inert), S9 (Informal–Formal), S10 (Decorative–Minimalist) and S11 (Artificial–Natural) that are not different in the perception of both the designers and the customers, as shown in Table 2.

### 4.2 *Identify the most preferred products*

The observation shows that the designers rate all the sample products in positive and almost higher than the customers except B1. Table 3 summarizes the highest positive and negative semantic values in perception of the designer and the customer for each product. According to the results from Figure 7, Table 2 and 3, it is found that the designer's perception differs to the customer's perception in certain semantics.

Figure 8 summarizes the most preferred products in perception of the designer and the customer regarding the average mean values of all semantics. It illustrates that B6 has the highest scores in the designer's perception whereas B1 has the highest scores in the customer's perception. Contrary to the designers, B6 has the lowest scores in the customer's perception whereas B2 has the lowest scores in the designer's perception. Although the customers almost rated B6 in the same aspect as the designers for each semantic, B6 still is not the most preferred for the customers, contrary it is the least preferred due to the big different values rated.

**Table 2**: Statistically significant differences between profiles and between product samples

| SD words | Profile | Product |
|---|---|---|
| $S_1$ | | ** |
| $S_2$ | | ** |
| $S_3$ | | * |
| $S_4$ | | ** |
| $S_5$ | | * |
| $S_6$ | ** | ** |
| $S_7$ | | |
| $S_8$ | ** | |
| $S_9$ | ** | |
| $S_{10}$ | ** | |
| $S_{11}$ | * | |
| $S_{12}$ | | ** |
| $S_{13}$ | ** | ** |
| $S_{14}$ | ** | * |
| $S_{15}$ | * | ** |
| $S_{16}$ | * | ** |
| $S_{17}$ | * | ** |

** α <0.05; ** α <0.01*

**Table 3**: Summary of high rating semantics related to customer's perception

| Products | Highest positive semantics | | Highest negative semantics | |
|---|---|---|---|---|
| | Designer | Customer | Designer | Customer |
| B1 | Simple | Trendy | Non-geometric | Non-geometric |
| B2 | Simple | Simple | Luxury | Luxury |
| B3 | Clean | Clean | Non-geometric | Non-geometric |
| B4 | Clean | Clean | Non-geometric | Luxury |
| B5 | Comfortable | Clean | Non-geometric | Non-geometric |
| B6 | Clean | Clean | Flat | Non-geometric |
| B7 | Comfortable | Natural | Ugly, Classic, Non-geometric | Non-geometric |
| B8 | Comfortable | Clean | Non-geometric | Non-geometric |

| Kansei words | Value | Best scores of designer | Kansei words | Value | Best scores of customer |
|---|---|---|---|---|---|
| Clean | 1.40 |  | Trendy | 1.10 |  |
| New | 1.00 | | New | 0.95 | |
| Anonymous | 0.92 | | Simple | 0.95 | |
| Simple | 0.88 | | Natural | 0.88 | |
| Trendy | 0.88 | B6 | Clean | 0.85 | B1 |
| **Kansei words** | **Value** | **Worst scores of designer** | **Kansei words** | **Value** | **Worst scores of customer** |
| Luxury | -0.68 |  | Active | -0.2 |  |
| Active | -0.64 | | Outstanding | -0.35 | |
| Decorative | -0.64 | | Complex | -0.43 | |
| Outstanding | -0.36 | | Decorative | -0.53 | |
| Artificial | -0.24 | B2 | Non-geometric | -0.8 | B6 |

**Figure 8**: Best and worst scores of the products rated by the designers and the customers

## 5 Conclusions

This paper applies SD technique and a statistical approach to observe the perception between the designers and the customers in the modern and contemporary style of bed furniture products. It uses the selected Kansei words (semantics) as mediators to explicit the emotion content of the designers and the customers. It has been proved that there are significant differences in perception between the designers and the customers in certain aspects for each product. The results of this study primarily notice the designers to beware of using their preferences for product design may not meet the customer's satisfaction. This study could further be developed to discover which design attributes (elements) of the products that affect emotions of the customers in order to determine the relationships between the design attributes and the semantics.

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