KANSEI ENGINEERING: THE INFLUENCE OF THE SCALE IN THE APPLICATION OF THE SEMANTIC DIFFERENTIAL

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Abstract

In the current market context products are technically akin. Therefore, there is a need to look for sources of differentiation that will allow companies launch products that will satisfy not just functional and economic needs, but also needs that cater for more emotional demands that will help establish affection bonds between the user and the product from the very moment the item is purchased.

As a result, there has been a shift from product design based on technological-criteria to a design of experiences rooted in sensitive and emotional criteria. People-oriented design has brought about the development of different methodologies such as the Quality Function Display (QFD), the Kano model or Kansei Engineering (KE).

In order to apply KE as a methodology for emotional design, the perceptions of consumers as regards a certain product must be measured. The most widely spread tool to accomplish this goal is the Semantic Differential (SD) method.

The article attempts to illustrate the influence of different scales in the gathering of data for the measurement of the perception of consumers as regards a certain product by applying SD methodology. In order to attain this objective a research about the perception of elevator cabin controls has been conducted.

Keywords: *Design and product development, People-centred design, Emotional Design, Kansei Engineering, Semantic Differential.*

1. Introduction

In the current market context products are technically akin. Therefore, there is a growing need to look for sources of differentiation that will allow companies launch products that will satisfy not just functional and economic needs, but also needs that cater for more emotional demands that will help establish affection bonds between the user and the product from the very moment the item is purchased.

As a result, there has been a shift from product design based on technological-criteria to a design of experiences rooted in sensitive and emotional criteria.

Nowadays consumers not only value functionality, usability and convenient prices when purchasing a certain product; but they also consider the emotions and sensations that this particular product elicits in them. Since a growing number of people want to assert their individuality, consumer goods have to adjust to individual demands, both in terms of design and functionality. When offered two products that have similar price and functionality consumers often come to a decision based on subjective features. They choose a product that produces a certain feeling or best reflects a certain life style, even if they are often unable to really explain what it was that made them prefer one product over another. Hence, considering that emotions play such a vital role in consumers' decisions, considerable competitive advantage can be obtained if these emotions are taken into account when designing a product.

In the past, manufacturers tried to cater for this growing demand through a more active integration of retail customers and users in the development phase of their products. In the 1950s and 1960s quality aspects started to be considered, although the latter was still regarded as a functional feature. In the 1980s usability and intangible features started to gain importance.

The attempt to integrate the impression a manufactured good produces on a customer is not new. Methods have gradually been developed since the 1970s. Companies have progressively increased the efficiency of their productive processes and invested more effort into managing the quality of their products. As a result, the variety and quality of these products has been improved. (Juran & Gryna, 1974).

In the 1990s, and through a combination of methods that integrated the customer's voice with a very flexible manufacturing process, it was finally possible to offer products that satisfied individual needs of users who demanded increasing quality, adaptation and personalization.

The constant change in users' requirements calls for the development of tools and methods to be applied to product development, which should consider and integrate yet the subtlest and most affectionate aspects. These are some of the methodologies considered (Schütte, 2005):

- Semantic Differential Method (SD) (Osgood et al., 1957). The method was first developed as a tool to measure the impact of political decisions on citizens. An adapted version of the SD method has proven successful when applied to product development.
- *Conjoint Analysis* (Green & Srinivasan, 1978). This tool was originally employed to find out how much money a target group was willing to spend on certain product features.
- Semantic Description of Environments (SMB). It was developed as a method to evaluate architectural structures based on their aesthetics.
- *Quality Function Deployment* (QFD) (Akao, 1990). This tool was developed by Japanese experts on quality management and it identifies the existing relation between functional needs of users and engineering characteristics.
- Kano Model (Kano et al., 1984). The Kano model is founded on the idea that users' needs can be grouped in different categories and levels.
- Kansei Engineering (KE) (Nagamachi, 1989). This engineering tool gathers emotional needs of users and establishes mathematical prediction models to show the relationship between those emotional needs and certain characteristics of the product being studied.

Kansei Engineering is considered the only methodology that has been specifically developed to quantify or evaluate the emotional needs of users and integrate them in the process of design.

Whereas there are different industrial methods which allow for the customers voice to be included in the development of the product, when it comes to measuring or evaluating emotions there are hardly any tools available. This deficit has brought about a growing interest of researchers on this field (ENGAGE, 2005).

2. Kansei Engineering as a methodology for people oriented design

The term Kansei is a Japanese word which is difficult to translate. To look at a work of art or, even an everyday object, can produce pleasant feelings which are difficult to describe. This is what the term Kansei refers to. Kansei is a subjective impression from an artifact, an environment, or a situation acquired through the senses (sight, hearing, feeling, smell, taste and *balance*) (Schütte, 2005).Thus, the term Kansei incorporates the meaning of the words: sensitivity, sense, aesthetics, feeling, emotion, affection and intuition (Lee et al., 2002). Shimizu relates the term Kansei to high level human abilities such as sensibility, recognition, identification, relationship making, and creativity. The process binding together of all these concepts is also part of Kansei (Shimizu et al., 2004).

A person's Kansei is expressed through physiological functions. There are different ways in which Kansei can be measured:

- Words
- Physiological responses (heart rate, sweating,…)
- People's behaviour and actions.
- Facial expressions and gestures. (Nagamachi, 2001)

The most frequent method to measure Kansei is through the use of semantic descriptors (adjectives, verbs, phrases…). Descriptors mirror Kansei elements (Schütte, 2005).

Kansei Engineering dates back to the 1970s and it was originally developed by Mitsuo Namagachi (Nagamachi, 1995) as an ergonomic consumer-oriented technology for product design. Nagamachi defines it as "the technology that translates consumers' feelings towards the product into elements of design". Nagamachi used the term 'Emotional Engineering and it was K. Yamamoto who first coined the term "*Kansei Engineering*" in 1986 at a lecture in the University of Michigan.

This methodology has helped develop some extremely successful products. Worldwide accredited companies such as Apple (where the work of Donald Norman must be underlined) make use of it. Mazda, Nissan and Mitsubishi have applied it to the development of automobiles and Sharp developed a video camera with an external LCD in Asia under the supervision of Mitsuo Nagamachi (Nagamachi, 1997a).

Other domains in which Kansei engineering has been applied are home furnishing, architecture and packaging design. The method has also been used in the finishing off of glass work (Barnes et al., 2004) and in the creation of ringing tones for mobile phones (Deng & Kao, 2003).

Nagamachi (Nagamachi, 1997b) gathered all the different applications of Kansei Engineering that had been set forth and grouped them according to the different tools used and the areas the method had been applied to. Based on this classification Namagachi identified different types of Kansei Engineering. At present six types of KE have been categorized (Nagamachi, 1997a; Nagamachi, 1999; Nagamachi, 2002; Schütte, 2005):

Kansei Engineering type I - Classification of Categories. It involves manual identification (polls to the objective market segment) of the relationship between emotional needs and the characteristics of the product. The relation is developed through tree diagrams.

Kansei Engineering Type II - Computer Aided KE System. It is a computer aided system that uses 4 data bases (Kansei descriptors, pictures, Kansei scores, designs and colors) and interference engines. The connections between Kansei descriptors and product properties are made through mathematical statistical tools (Nagamachi, 2001).

Kansei Engineering Type III - Hybrid Kansei Engineering System with backward and forward reasoning. Similar to KE type II. However, it not only suggests product properties that provide a certain Kansei, but it also predicts the Kansei that a product or a new design will elicit (Matsubara & Nagamachi, 1997).

Kansei Engineering type IV - Kansei Engineering Modeling Similar to the two previous systems (KE I & II) although it uses more complex mathematical models (regression, fuzzy logic, neuronal networks,...) in order to link data bases.

Kansei Engineering type V - Virtual KE. It integrates KE with virtual reality techniques. The stimulus (picture) is replaced by a stimulus generated through virtual reality or augmented reality tools.

Kansei Engineering Type VI - Collaborative KE Designing. The Kansei data base is Internet accessible which allows for team work and concurrent engineering (Nagamachi, 1997b; Nagamachi, 2001).

Kansei Engineering is essentially a product development methodology which translates users' impressions, feelings, desires and demands into design solutions and actual design parameters.

3. The Semantic Differential Method (SD) as a means to capture the perceptions of people

The Semantic Differential Method is a psychological evaluation tool that was created in 1957 by Charles Osgood, George Suci and Percy Tannenbaum. The method was originally developed to assess the perception of North American citizens as regards the political propaganda of the time. Thirty years later the method was adapted to measure the consumers' perception of a certain object and it became one of the central pillars of Kansei Engineering.

SD deals with the study of affective meaning. That is to say, it analyses the emotional reactions that are associated to a particular word (descriptor). The method is based on subjective estimations as regards a concept, object or image and its subsequent analysis (Osgood et al., 1957). As a result of the randomness of the answers provided, SD cannot be regarded as an objective method; but it is better suited than other methods which obtain information through physiological means. SD provides no information about the meaning of the object or image under scrutiny, but rather, it supplies valuable data about the feelings or perceptions it elicits. In fact, the method is applicable because the interaction between the user and the object is made understandable through the use of words (descriptors) that are emotionally loaded (Schütte, 2005).

The procedure of the Semantic Differential method should observe the following stages. First, the words or terms that define the domain of the research must be gathered. The sources from which these terms can be captured are very diverse (related literature, advertising, survey finds among experts, user polls, etc.) Afterwards, the list of terms gathered is reduced through a number of steps and on the grounds of different criteria. Eventually, this list will be condensed to the terms that have the biggest impact on users' minds when thinking of a particular object or concept. The terms gathered should include the company's brand values.

In the next step, the semantic structure of the terms on the list is identified. Technically this could be done through an experimental research and a subsequent factorial or cluster analysis (Hair et al., 1995) or by completing an affinity diagram.

After that, the products or concepts that will serve as stimuli for the emotional evaluation must be identified.

Finally, the information stemming from the emotional evaluations is obtained by assembling a number of volunteers which will be asked to rank the given stimuli in the light of a number of semantic scales (Osgood & Suci, 1969). The respondents will have to select the values that best adapt to their sensitive-emotional preferences.

4. Scales as units of measurement of people's perceptions

Most of the evaluation methods applied in Kansei Engineering involve user polls. The main components of such polls are questionnaires, including different kinds of rating scales.

In order for the person being surveyed to understand how to answer questionnaires the scales are usually named at the extremes. The selection of the term (descriptor) that will be used in the questionnaire is of extreme importance, results depending on this fact to a large extent. The descriptors should be easy to understand for the respondent.

In Kansei Engineering each term (descriptor) that will be evaluated is linked to an individual scale. However, on account of practicality, and depending on cultural and personal preferences, there are various ways in which this scale, and the descriptors involved, can be displayed.

Osgood (Osgood et al., 1957) uses a synonym and its corresponding antonym to span the range of rating (compare Figure 1a). This scheme allows for two terms to be rated simultaneously which means that the range of rating is immediately marked out and there is a reduction in the number of descriptors being rated. However, it is not always easy to find terms which are opposite in meaning and manage to mark out the range of rating at the desired point.

Nagamachi and other Japanese researchers place the selected descriptor for evaluation on one extreme (e.g. attractive) and its reversal (e.g. non-attractive) on the other (compare Figure 1b). Hence, the need to find an antonym is avoided. However it has been proven that the resulting distribution of data is not balanced.

Other researchers choose a hybrid option between the two scales. The term that needs to be rated is placed on the central top part of the scale and "Not at all" "Very Much" are written at opposite ends (compare Figure 1c). The first and last scales are the ones that provide a more leveled distribution of data.

a) Synonym |---------------------------| Antonym
b) Synonym |---------------------------| Non Synonym
c) Not at all |---------------------------| Very Much

Figure1. Most widely used scales in semantic evaluations

Another important aspect to bear in mind is the number of rating levels in the scale. Osgood (Osgood et al., 1957) uses seven levels (compare Figure 2a), whereas Namagachi and other Japanese researchers (Nagamachi, 2001) and (Sinclair, 1990) use five level scales (compare Figure 2b).

The five level scale has often proven too narrow, particularly when a neutral descriptor is placed in the middle of the scale. When this is the case, respondents do not generally consider the two anchors (descriptors) at the extremes, and so the three remaining terms are usually ill fitted to attain an apt rating (Schütte, 2005).

The seven level scale allows for a more detailed rating and it is as easy to understand and as convenient to use as the five level scale.

In fields relating health, a scale known as the *Visual-Analogue Scale* (VAS), often called '*Quality of Life Scale*', is used. This scale is a 100mm long segment in which respondents can mark their estimation by writing an X in the point they consider appropriate (compare Figure 2c). This scale is often more difficult to interpret than other scales.

Robust

a) Not at all ☐ ☐ ☐ ☐ ☐ ☐ ☐ Very much

Robust

b) Not at all ☐ ☐ ☐ ☐ ☐ Very much

Robust

c) Not at all |----X--------------------| Very much

Figure 2. Scale levels most frequently used in semantic ratings

Guilford (Guilford, 1971) suggests that the position of the descriptors should be random. Thus, a number of deficiencies derived from the completing of surveys, such as the learning effect, or the weariness effect, can be avoided.

5. Objective of the research

In any Kansei Engineering application the stage in which data is collected is crucial. For this reason the present research aims to analyze the influence of the different scales used in the gathering of data for the *subsequent* rating of the perception of consumers by using the Semantic Differential (SD) method. With this objective in mind a perception study concerning elevator cabin controls has been conducted.

6. Practical application

Kansei Engineering has been mostly applied to consumer goods, although it has also been validated for industrial products such as construction machinery, machine switches or machine tools (Nakada, 1997; Schütte & Eklund, 2005; Mondragón et al., 2005).

The present article deals with a study applied to elevator cabin controls. One of the objectives of the research is to analyze the influence of the scale on the application of the Semantic Differential. With that aim a survey has been designed. The questionnaire comprises 56 semantics (descriptors), namely 28 positive adjectives and their corresponding 28 antonyms (Compare Figure 3). These descriptors have been grouped in two different scales (1) in pairs formed by a descriptor and its corresponding antonym (double scale), and (2) a single list comprising all 56 semantics (simple scale).

1	Pleasant (Agradable)	Unpleasant (Desagradable)	15	User friendly (Fácil de usar)	Difficult to use (Difícil de usar)
2	High quality (Alta calidad)	Low quality (Baja calidad)	16	Feminine (Femenina)	Masculine (Masculina)
3	High tech (Alta tecnología)	Low tech (Poca tecnología)	17	Reliable (Fiable)	Non reliable (De poca confianza)
4	Harmonius (Armoniosa)	Discordant (Desequilibrada)	18	Expensive looking (Imagen de cara)	Cheap looking (Imagen de barata)
5	Well finished off (Bien acabada)	Poorly finished (Mal acabada)	19	Young (Juvenil)	Mature (Maduro)
6	Nice looking (Bonita)	Ugly (Fea)	20	Ligth (Ligera)	Heavy (Pesada)
7	Good (Buena)	Bad (Mala)	21	Flashy (Llamativa)	Plain (Sencilla)
8	Classic (Clasica)	Futuristic (Futurista)	22	Luminous (Luminosa)	Dark (Oscura)
9	Complex (Complicada)	Simple (Simple)	23	Modern (Moderna)	Old fashioned (Anticuada)
10	Conventional (Corriente)	Stylish (De diseño)	24	Very practical (Muy práctica)	Impractical (Poco práctica)
11	Dazzling (Deslumbrante)	Modest (Discreta)	25	Unique (Original)	Common (Común)
12	Distinguished (Distinguida)	Vulgar (Vulgar)	26	Proportionate (Proporcionada)	Non proportionate (Desproporcionada)
13	Too large (Excesiv. grande)	Too small (Excesiv. pequeña)	27	Robust (Robusta)	Flimsy (Endeble)
14	Exclusive (Exclusiva)	Dull (Ordinaria)	28	Sober (Sobria)	Over elaborate (Recargada)

Figure 3. Semantics and their antonyms used in the study of elevator cabin controls

The scale including descriptors and their corresponding antonyms contains seven rating levels between the semantic and its antonym; whereas the single list scale comprising the 56 descriptors allows for seven rating levels in between ‘Not at all’ and ‘Very much’. The same respondent was asked to complete two different surveys (type1 and type 2), as shown in Figure 4, concerning two different stimuli (pictures of two cabin controls). In both questionnaires descriptors are provided randomly, in a different order for each respondent. In questionnaire type (1) the position of the descriptor in the column is also randomized.

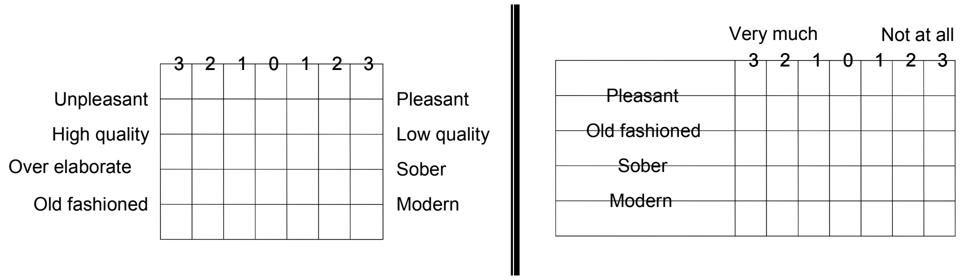

Figure 4. Double and Simple Scales in the study of elevator cabin controls

The stimuli for the rating consist of 42 pictures of elevator cabin controls (compare Figure 5).

Each respondent rated two different pictures, one using the simple scale and another by completing the double descriptor scale. Thus, 126 subjects, most of them Industrial Design Engineering students and professors from Mondragon Unibertsitatea, rated the pictures. The poll has resulted in 256 interviews, 6 surveys per picture.

Figure 5. Pictures of elevator cabin controls used for research

7. Results analysis

Once the interviews were completed, the subsequent analysis included the following steps:

- Analysis and examination of the perception rank of the semantics.
- Hierarchical cluster analysis of agglomeration through the centroid method in order to classify the semantic universe into positive and negative descriptors, both for double and simple scales.
- Hierarchical cluster analysis of agglomeration through the centroid method in order to group the descriptors and propose a coherent reduction of data.

The analysis and examination of the perception rank of the descriptors resulted in a virtually maximum perception rank of the descriptors used which means that:

- The variables have proven clear enough for the respondents since they have used them in their full extension, and/or that
- A wide variety of controls (stimuli) have been provided which has allowed for all kinds of results/opinions.

The hierarchical cluster analysis of agglomeration through the centroid method in order to classify the semantic universe into positive and negative descriptors, both for double and simple scales, has resulted in the following findings:

- As expected, the classification of positive and negative double descriptors has resulted in the same preliminary grouping of the terms and their antonyms, 28 positive and 28 negative ones
- In the classification of the simple descriptors three pairs fail to match the preliminary grouping of the terms and their antonyms. Besides, the distribution has not been balanced (29 positive and 27 negative)
- When these three descriptors and their antonyms are proposed as simple in the questionnaire they fail to prove as such; or, in any case, these descriptors are not

regarded as antonyms by the respondents when rating elevator cabin controls. This cannot occur in double scales since they are coupled in the scale.

Hence, it is revealed that the double scale helps interpret descriptors in their original sense, i.e. in the direction intended by the survey when it was first designed; whereas in the simple scale the significance of each semantic is subject to the interpretation of the respondent, allowing for cultural, geographical or social factors to interfere.

The conclusion the findings draw to, is that in order to guarantee a certain degree of reliability; that is to say, in order for the respondent to correctly infer the meaning of original terms, the use of 'ambiguous' descriptors should be avoided when using a simple scale. Another feasible option is the use of double scales which will clarify the meaning of the concept. Similarly, the use of 'ambiguous' descriptors as group representatives should be avoided.

After the positive/negative classification has been obtained, another hierarchical cluster analysis of agglomeration through the centroid method has been undertaken in order to group the descriptors and propose a coherent reduction of data. This analysis is applied both to the 28 positive descriptors of the double scale and to the 29 semantics of the simple scale.

In order to choose the number of conglomerates that will be used in the final study the distance in between the conglomerates in each successive step has been calculated and the cases in which distance exceeds 0.1 have been analyzed so as to select the final quantity. After the analysis the number of selected conglomerates is 20 for the double scale and 19 for the simple scale.

After a comparative examination of the resulting conglomerates has been conducted, the following can be concluded:

- The preliminary descriptors are not identical as a result of the positive/negative distribution.
- The number of descriptors obtained through the cluster analysis is reduced from the 28 initial descriptors down to 20 in the case of double scales. In the case of simple scales the descriptors are reduced from the initial 29 to the final 19.
- The conglomerates obtained are not identical either, nor in quantity nor in their constituents. Only 8 descriptors coincide.
- If resulting conglomerates are analyzed separately it can be concluded that most are the result of a logical agglomeration, both in the case of double and simple scales.
- As aforementioned, the use of 'ambiguous' semantics as 'representative' should be avoided.

8. General conclusions

After comparing the effect of the use of the two different scales upon the perception of respondents, and in the light of the results and conclusions derived from the research undertaken, the following findings standout:

- A lesser amount of time is required to complete surveys in the case of double scales. It is important to consider this fact when dealing with large numbers of questionnaires and products, since each respondent should ideally rate every single product.
- The use of double scales helps respondents infer the meaning of descriptors in the direction intended by the survey when it was first designed. Reversely, when using a

simple scale the meaning of each descriptor is subject to the interpretation of the respondent, allowing for cultural, geographical or social factors to interfere. The study has revealed that the great majority of doubts the respondents evidenced about the interpretation of descriptors concerned simple scales.

- Once the questionnaires have been completed, the results of the analyses of hierarchical conglomerates present no substantial differences in positive descriptors of neither double nor simple scales. That is to say, the results of those analyses when examined separately are not significantly different. Hence, the semantic study could be successfully undertaken by choosing either one.
- The stage in which surveys are conducted remains the main source of disparity between the application of a double or a simple scale. These differences stem from the phase in which data is collected, which is a decisive moment for the successful advance of the investigation.
- The conclusions and findings reveal that the application of the double scale offers advantages over the application of the simple scale.

9. References

Akao, Y., *“History of Quality Function Deployment in Japan”*. Hansa Publisher, 1990

Barnes, C. J., Childs, T. H. C., Henson, B. and Southee, C. H., “Surface finish and touch- a case study in a new human factors tribology”, *WEAR*, Vol. 257, 2004, pp. 740-750.

Deng, Y. and Kao, Y. P., *“The development of musical selection plan based on kansei similarity”*, National Chiao Tung University, Institute of Applied Art, 2003.

ENGAGE, “European Project on Engineering Emotional Design”, *Report of the State of the Art-Round 1*. Report Valencia, 2005.

Green, E. P. and Srinivasan, V., “Conjoint Analysis in consumer research”. *Journal of consumer research*, Vol. 5, September, 1978.

Guilford, J. P. (1971), *“Psychology Methods”*, McGraw-Hill, New York, 1971.

Hair, J. F., Anderson, R. E., Tatham, R. L. and Black, W. C., *“Multivariate Data Analysis with Readings”*. Prentice-Hall, London, 1995.

Juran, J., Gryna, F. M. and R.S., B., *“Quality Control Handbook”*, McGraw-Hill, New York, 1974.

Kano, N., Seraku, N. and Takahashi, F., “Attractive quality and must be Quality”, *Quality*, Vol. 14 No.2, 1984, pp. 39-44.

Lee, S., Harada, A. and Stappers, P. J., *“Pleasure with Products: Design based Kansei”. Pleasure with Products: Beyond usability, Green, W. and Jordan, P.*, Taylor & Francis, London, pp. 219-229, 2002.

Matsubara Y.and Nagamachi M., “Hybrid Kansei Engineering System and design support”, *International Journal of Industrial Ergonomics*, Vol.19, 1997, pp.81-92.

Mondragón, S., Company, P. and Vergara, M., “Semantic Differential applied to User-Centred Machine Tool Design”, *International Journal of Industrial Ergonomics*, Vol.35, 2005, pp.1021-1029.

Nagamachi M., “Kansei Engineering as a powerful consumer-oriented technology for product development”, *Applied Ergonomics*, Vol.33, 2002, pp. 289-294.

Nagamachi M., “Kansei Engineering: a new ergonomic consumer-oriented technology for product development”, *International Journal of Industrial Ergonomics*, Vol.15, 1995, pp.3-11

Nagamachi M., “Kansei Engineering: the Implication and Applications to Product Development.Systems”, *IEEE SMC '99 Conference Proceedings*. IEEE, 1999, Vol 6, pp. 273-278

Nagamachi, M. (1997a), “Requirement identification of consumer's needs in product design”, *Proceedings of IEA '97*, 1997, Finnish Institute of Occupational Heath, Tampere, Finland, p. 231-233.

Nagamachi, M. (1997b), *“Kansei Engineering: The Framework and Methods”*, *Kansei Engineering 1*, Nagamachi, M. (ed.), Kaibundo Publishing Co. Ltd., Kure, 1997, pp. 1-9.

Nagamachi, M., *“Kansei Engineering”*, Kaibundo, Tokyo, 1989.

Nagamachi, M., “Workshop 2 on Kansei Engineering”, *Proceedings of International Conference on Affective Human Factors Design, Singapore*, 2001.

Nagasawa, S. “Kansei and Business”, *Kansei Engineering International- International Journal of Kansei Engineering*, Vol. 3, 2002, pp. 2-12.

Nakada, K., “Kansei engineering research on the design of construction machinery”, *International Journal of Industrial Ergonomics*, Vol. 19, 1997, pp. 129-146.

Osgood, C. E. and Suci, G. J., *“Factor Analysis of Meaning. Semantic Differential Technique - a Source Book, Osgood, C. E. and Snider, J. G.”*, Aldine Publishing Company, Chicago, pp. 42-55, 1969.

Osgood, C. E., Suci, G. J. and Tannenbaum, P. H., *“The Measurement of Meaning”*, University of Illinois Press, Illinois, 1957.

Schütte, S., *“Engineering Emotional Values in Product Design”*, Kansei Engineering in Development. Dissertation 95, Linköpings Universitet, 2005.

Schütte, S. and Eklund, J., “Design of rocker switches for work-vehicles-an application of Kansei Engineering”. *Applied Ergonomics*, Vol. 36, 2005, pp. 557-567.

Shimizu, Y., Sadoyama, T., Kamijo, M., Hosoya, S., Hashimoto, M., Otani, T., Yokoi, K., Horiba, Y., Takatera, M., Honywood, M. and Inui, S., “On-demand production system of apparel on basis of Kansei engineering”, *International Journal of Clothing Science and Technology*, Vol.16, 2004, pp.32-42.

Sinclair, M. A., *“Subjective assessment, Evaluation of Human Work- A practical ergonomics methodology, R., W. J. and Corlett, E. N.”*, Taylor and Francis, London, pp. 58-88, 1990.

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