

This paper should be cited as: Schütte, S. (2007). Towards a common Approach in Kansei Engineering. A proposed model. *Proceedings of the Conference: Interfejs użytkownika - Kansei w praktyce, Warszawa 2007* (pp. 8–17). Warsaw: Wydawnictwo PJWSTK.

Simon Schütte

Towards a common Approach in Kansei Engineering

A proposed model
Linköping University,
Sweden, IEI/ Q, SE-58183

> Abstract

> Kansei Engineering is a method dealing with the design of affective values into product solutions. Many other methods are existing in this area but Kansei Engineering has proven to be one of the most powerful tools. In Japan, where Kansei Engineering was originally invented it is used frequently by researchers and companies in highly different purposes. Consequently, many different types, applications and philosophies exist. This paper gives a short overview on the area and proposes a common model on Kansei Engineering as an attempt to map a general procedure of Kansei Engineering studies. Kansei Engineering has often been criticized for its heavy statistics making it difficult to apply for non-specialists. One solution is the development of expert software performing Kansei Engineering studies. This paper describes in brief two software tools developed at Linköping University in Sweden.

> Keywords: Affective Engineering, proposed Model, software tools

> Introduction

> The design of products on today's markets often become increasingly complex since they contain more functions and they have to meet more demands on e.g. user-friendliness, manufacturability and ecological consideration. Shortened product life cycles

are likely to increase development costs. This contributes to making errors in estimations of market trends very expensive. Companies therefore perform benchmarking studies that compare competitors on strategic-, process-, marketing- and product level. Also, they need a reliable instrument, which can predict the product's reception on the market before the development cost gets too critical.

- However, success in a certain market segment does not only require knowledge about the competitors and their products' performance, but also about the impressions the products make on the customer. The latter requirement becomes much more important the more mature the products and the companies are. This means that the customer purchases a product based on more subjective terms such as manufacturer image, brand image, reputation, design, impression etc., although the products seem to be equal. A large number of manufacturers have started development activities to consider such subjective properties so that the product expresses the company image.
- This demand triggers the introduction of a new research field dealing with the collection of customers' hidden subjective needs and their translation into concrete products. Research is done foremost in Asia, namely Japan and Korea. In Europe a network has been forged under the 6th EU framework [1] (compare www.engage-design.org). This network refers to the new research field as "emotional design" or "affective engineering".

➤ Affective Engineering

- Nowadays, people want to use products that should be functional at a physical level, usable at a physiological and psychological level and should be attractive at a subjective, emotional level. Affective engineering is the study of the interactions between the customer and the product at that third level. It focuses on the relationships between the physical traits of product and its affective influence on the user. Thanks to this field of research, it is possible to gain knowledge on how to design more attractive products and make the customers satisfied.

➤ Methods in Affective Engineering

- The area of integrating affective values in artifacts is not new at all. Already in the 14th century philosophers such as Baumgarten and Kant established the area of aesthetics. In addition to pure practical values, artifacts always also had an affective component [2, 3]. One example is jewellery found in excavations from the stone ages. Also the period of renaissance is a good example of that.
- In the middle of the 19th century, the idea of aesthetics was deployed in scientific contexts. Charles E Osgood developed his Semantic Differentials Method in which he quantified the peoples' perceptions of artifacts [4]. Some years later, in 1960, Professors Shigeru Mizuno and Yoji Akao developed an engineering approach in order to connect peoples' needs to product properties. This method was called Quality Function Deployment (QFD) [5]. Another method, the Kano model was developed in the field of quality in the early

1980s by Professor Noriaki Kano, of Tokyo University. Kano's model is used to establish the importance of individual product features for the customer's satisfaction and hence it creates the optimal requirement for process oriented product development activities [6]. A pure marketing technique is Conjoint Analysis. Conjoint analysis estimates the relative importance of a product's attributes by analyzing the consumer's overall judgment of a product or service [7]. A more artistic method is called Semantic description of environments (Swedish: Semantisk Miljöbeskrivning, SMB). It is mainly a tool for examining how a single person or a group of persons experience a certain (architectural) environment [8].

> Although all of these methods are concerned with subjective impact, none of them can translate this impact to design parameters sufficiently. This can, however, be accomplished by Kansei Engineering. Kansei Engineering (KE) has been used as a tool for affective engineering. It was developed by Professor Mitsuo Nagamachi in the early 70ies in Japan and is now widely spread among Japanese companies. In the middle of the 90ies, the method spread to the United States, but cultural differences may have prevented the method to enfold its whole potential [9].

> Kansei Engineering Procedure

> As mentioned above, Kansei Engineering can be considered as a methodology within the research field of 'Affective Engineering'. Some researchers have defined the content of the methodology. Shimizu et al. state that 'Kansei Engineering is used as a tool for product development and the basic principles behind it are the following: identification of product properties and correlation between those properties and the design characteristics' [10].

> According to Nagamachi [11], one of the forerunners of Kansei Engineering, there are three focal points in the method:

- How to accurately understand consumer Kansei
- How to reflect and translate Kansei understanding into product design
- How to create a system and organization for Kansei orientated design

> Figure 1 shows how Kansei Engineering works in principle.

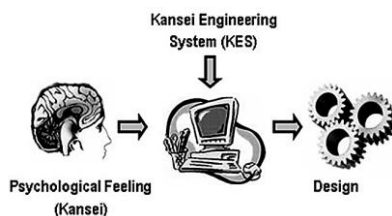


Figure 1: Kansei Engineering System (KES) adapted from [12].

> Assume that you have problem with your old mobile phone. Hence you have decided to buy a new one and you have not determined yet whether to stay with your old brand or try another make. Collecting information you start looking on the Internet about other brand's models and also ask your co-workers about their experience with mobile phones. Finally, you find one that seems to be 'right' for your needs and you decide to buy it. However, when you are standing in front of the phone at the store, you suddenly realize that the phone does not meet your expectations; it simply 'feels' wrong. Consequently, affective (emotional) values have a big influence on the buying decision. Being able to take them into consideration already in the design phase of a product can give a big advantage in competition.

> A Model on Kansei Engineering Methodology

> In Japanese publications, different types of Kansei Engineering are identified and applied in various contexts. Schütte [13] examined different types of Kansei Engineering and developed a general model covering the contents of Kansei Engineering. This model is presented in Figure 2.

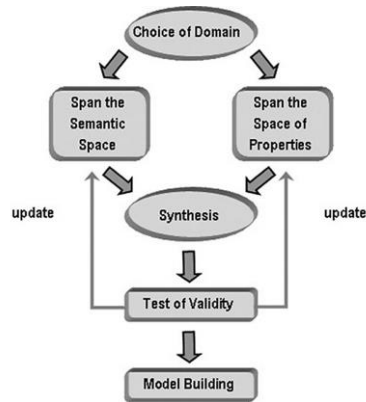


Figure 2: A general model on Kansei Engineering [13].

> Choice of Domain

> 'Domain' in this context describes the overall idea behind an assembly of products, i.e. the product type in general. Choosing the domain includes the definition of the intended target group and user type, market-niche and type, and group of the product in question. Choosing and defining the domain is carried out including existing products, concepts and as yet unknown design solution. From this, a domain description is formulated serving as basis for further evaluation. Schütte [13-15] describes the processes necessary in detail in a couple of publications.



> Span the Semantic Space

> The expression 'Semantic Space' was addressed for the first time by Osgood et al.[4]. He posed that every artifact can be described in a certain vector space defined by semantic expressions (words). This is done by collecting a large number of words that describe the domain. Suitable sources are pertinent literature, commercials, manuals, specification list, experts etc. The number of the words gathered typically varies, depending on the product between 100 and 1000 words. In a second step the words are grouped using manual (e.g. Affinity diagram, compare: Bergman and Klefsjö, 1994) or mathematical methods (factor and/or cluster analysis, compare: Ishihara et al., 1998). Finally a few representing words are selected from this spanning the Semantic Space. These words are called Kansei words or Kansei Engineering words.

> Span the Space of Properties

> The next step is to span the Space of Product Properties, which is similar to the Semantic Space. The Space of Product Properties collects products representing the domain, identifies key features and selects product properties for further evaluation.

> The collection of products representing the domain is done from different sources such as existing products, customer suggestions, possible technical solutions and design concepts etc. The key features are found using specification lists for the products in question. To select properties for further evaluation, a Pareto-diagram (compare Bergman and Klefsjö, 1994) can assist the decision between important and less important features.

> Synthesis

> In the synthesis step, the Semantic Space and the Space of Properties are linked together, as displayed in Figure 3. Compared to other methods in Affective Engineering, Kansei Engineering is the only method that can establish and quantify connections between abstract feelings and technical specifications. For every Kansei word a number of product properties are found, affecting the Kansei word.

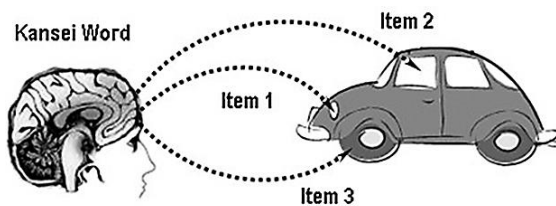


Figure 3: Synthesis phase.

➤ The research into constructing these links has been a core part of Nagamachi's work with Kansei Engineering in the last few years. Nowadays, a number of different tools is available. Some of the most common tools are :

- Category Identification [11]
- Regression Analysis /Quantification Theory Type I [16]
- Rough Sets Theory [17]
- Genetic Algorithm [18]
- Fuzzy Sets Theory [19]

➤ Model building and Test of Validity

➤ After doing the necessary stages, the final step of validation remains. This is done in order to check if the prediction model is reliable and realistic. However, in case of prediction model failure, it is necessary to update the Space of Properties and the Semantic Space, and consequently refine the model.

➤ The process of refinement is difficult due to the shortage of methods. This shows the need of new tools to be integrated. The existing tools can partially be found in the previously mentioned methods for the synthesis.

➤ Software Tools for Kansei Engineering

➤ Kansei Engineering has always been a statically and mathematically advanced methodology. Most types require good expert knowledge and a reasonable amount of experience to carry out the studies sufficiently. This has also been the major obstacle for a widespread application of Kansei Engineering.

➤ In order to facilitate application some software packages have been developed in the recent years, most of them in Japan. There are two different types of software packages available: User consoles and data collection and analysis tools. User consoles are software programs that calculate and propose a product design based on the users' subjective preferences (Kanseis). However, such software requires a database that quantifies the connections between Kanseis and the combination of product attributes. For building such databases, data collection and analysis tools can be used. This part of the paper demonstrates some of the tools. There are many more tools used in companies and universities, which might not be available to the public.

➤ User consoles

➤ One of the first and most famous software is a program for kitchen design [20, 21]. It was developed by Professor Nagamachi in corporation with Matsushita works, a kitchen

manufacturer. Potential buyers of a kitchen answered a number of questions regarding their personal background, lifestyle and taste. Based on this, a computer generates a proposed virtual 3-D picture of kitchen design to new potential buyers including an order list for the different modules.

➤ Kansei Engineering Software (KESo)

As described above, Kansei data collection and analysis is often complex and connected with statistical analysis. Depending on which synthesis method is used, different computer software is used. Kansei Engineering Software (KESo) uses QT1 for linear analysis. The concept of Kansei Engineering Software (KESo) was developed by Schütte [22]. The software generates online questionnaires for collection of Kansei raw-data as seen in Figure 4.



Figure 4: The consumer data collection page.

- Potential customers are asked to give their opinions and subjective impressions about a product on a computer terminal or at home on the Internet. The customers can see a product image, watch a movie of the product or listen to a sound of the product. If it is necessary to have a more close contact with the product using e.g. the senses of touch, smell or taste, samples must be provided in order to achieve a complete Kansei. On small sliders in the browser window, the customers rate the products according to the presented Kansei words.
- After sufficient information has been collected, the raw-data is moved from the server to KESo and analyzed. KESo establishes the relations of the Kansei words and different product properties as necessary for the synthesis. The method used is Quantification Theory Type I (QTI) as explained previously. A prediction model is build of how

a certain product is perceived of the customer group in question. This information can be used for improvement and development of new products.

- Figure 5 shows the working area of the KESo software. Here, the Kansei words are put in as well as the product concepts necessary for evaluation. The software also supports the choice of a good experimental design in order to obtain sufficient data effectively. Then a webpage is generated. When Kansei raw data has been collected, the item “Analyze” in the “Tools” menu enables the user to start the QT1 analysis.

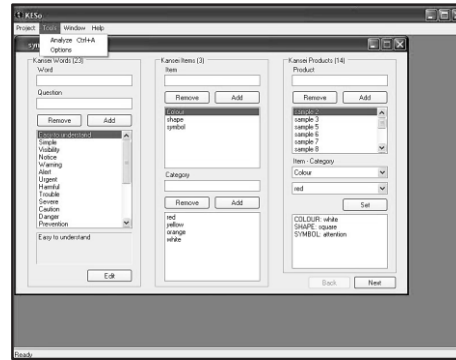


Figure 5: Kansei Engineering software (KESo).

➤ Concluding remarks

- Kansei Engineering methodology is a relatively new method. It was developed in the 1970ies based on the demand of the Japanese industry to design products with improved affective values. In the recent years the demand of those products in particular on saturated markets has been increasing hugely. With it the usage of affective engineering methods is also expanding. Kansei Engineering has been proven to be one of the most reliable and powerful tools for this task. It can not only treat obvious product properties such as exterior design but also measure the affective impact of less noticeable product parts such as technical components “under the hood”.
- Kansei Engineering has sometimes been criticized for its application of advanced statistics. The mathematical tools are the reason for its reliability but also prevent the spreading of Kansei Engineering since significant expertise is required. The introduction for software tools might improve this aspect. This also can help to overcome the lack of innovativeness Kansei Engineering is sometimes accused for.
- Future development of Kansei Engineering will certainly lay on integration of new tools for synthesis and structure mapping. In order to improve the credibility of Kansei Engineering

and Affective Engineering as a new area of research more interdisciplinary and international cooperation is probably necessary.

> Bibliography

- ENGAGE, European Project on Engineering Emotional Design Report of the State of the Art- Round 1. 2005: Valencia.
- Baumgarten, A.G., *Aesthetica*. 1961, Hildesheim: Georg Olms Verlagsbuchhandlung.
- Kant, I., *Kritik av det rena förnuftet*. 2004, Stockholm: Thales.
- Osgood, C.E., G.J. Suci, and P.H. Tannenbaum, *The measurement of meaning*. 1957, Illinois: University of Illinois Press. 346.
- Akao, Y., *History of Quality Function Deployment in Japan*. International Academy for Quality Books Series. Vol. 3. 1990: Hansa Publisher.
- Kano, N., N. Seraku, and F. Takahashi, *Attractive quality and must be quality*, in *Quality*. 1984. p. 39-44.
- Green, E.P. and V. Rao, *Conjoint Measurement for Quantifying Judgemental data*. *Journal of Marketing Research*, 1971: p. 61-68.
- Küller, R., *Semantisk Miljö Beskrivning (SMB)*. 1975, Stockholm: Psykologiförlaget AB Liber Tryck Stockholm.
- Nagamachi, M., *Kansei Engineering*. 1989, Tokyo: Kaibundo Publishing Co. Ltd.
- Shimizu, Y., et al., *On-demand production system of apparel on basis of Kansei engineering*. *International Journal of Clothing Science and Technology*, 2004. 16(1/2): p. 32-42.
- Nagamachi, M. *Workshop 2 on Kansei Engineering*. in *International Conference on Affective Human Factors Design*. 2001. Singapore, 2001.
- Nagamachi, M., *Kansei Engineering: A new ergonomic consumer-oriented technology for product development*. *International Journal of Industrial Ergonomics*, 1995. 15: p. 3-11.
- Schütte, S.T.W., *Designing Feeling into Products-Integrating Kansei Engineering Methodology in Product Development*, in *Institute of Technology*. 2002, Linköpings university: Linköping. p. 184.
- Schütte, S., et al., *Concepts, methods and tools in Kansei Engineering*. *Theoretical Issues in Ergonomics Science*, 2004. 5: p. 214-232.
- Schütte, S., *Engineering emotional values in product design- Kansei Engineering in development*, in *Institution of Technology*. 2005, Linköping University: Linköping.
- Nishino, T., *Exercises on Kansei Engineering*. 2001: Hiroshima International University.
- Mori, N., *Rough set approach to product design solution for the purposed "Kansei"*. *The Science of Design Bulletin of the Japanese Society of Kansei Engineering*, 2002. 48(9): p. 85-94.
- Nishino, T., et al. *Internet Kansei Engineering System with Basic Kansei Database and Genetic Algorithm*. in *TQM and Human Factors*. 1999. Linköping, Sweden: Centre for Studies of Humans, Technology and Organization.
- Shimizu, Y. and T. Jindo, *A fuzzy logic analysis method for evaluating human sensitivities*. *International Journal of Industrial Ergonomics*, 1995. 15: p. 39-47.

- Matsubara, Y. and M. Nagamachi, Kansei Virtual Reality Technology and Evaluation on Kitchen Design, in Manufacturing Agility and Hybrid Automation - 1, R.J. Koubek and W. Karwowski, Editors. 1996, IEA Press: Louisville, Kentucky, USA. p. 81-84.
- Imamura, K., et al., An Application of Virtual Kansei Engineering to Kitchen Design, in Kansei Engineering 1, M. Nagamachi, Editor. 1997, Kaibundo Publishing Co., Ltd.: Kure. p. 63-68.
- Schütte, R., Developing an Expert Program software for Kansei Engineering, in Institute of Technology, Linköping University. 2006, Linköping University: Linköping.