DEVELOPMENT AND APPLICATION OF ONLINE TOOLS FOR KANSEI ENGINEERING EVALUATIONS

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ABSTRACT

Kansei Engineering is a methodology seeking to grasp customers' feelings and subjective affective opinion of products as well as turning their affective needs into suitable product concepts. The procedure is rather complex and requires a fair amount of interdisciplinary expertise and experience in order to achieve reliable results. The high threshold to learn those techniques is preventing many practitioners from applying it. There are, however, software packages that have supported product designers to perform Kansei Engineering evaluations without being experts in the field of statistical mathematics. This paper will give a short overview on Kansei procedure, and the methods attached to it, and shows present and future areas of application for computerized tools in Kansei Engineering.

1. BACKGROUND AND INTRODUCTION

Kansei Engineering is a methodology seeking to grasp customers' feelings and subjective affective opinion on products as well as turning their affective needs into suitable product concepts. In comparison to other R&D tools, the methodology does not spread as fast as the success story would lead one to assume. One of the reasons might be that the procedure is rather complex and requires a fair amount of interdisciplinary expertise and experience in order to achieve reliable results. This means that the high threshold to learn affective engineering technique is preventing many practitioners from applying it. A solution was the development of software tools which automatized whole or parts of the Kansei Engineering processes. Most of those tools were Japanese, but some were developed in Europe. Among others, Linköping University developed a general software package that supported product designers to perform Kansei Engineering evaluations without being experts in the field of statistical mathematics.

2. PURPOSE OF THIS PAPER

This paper will give a short overview on Kansei procedure and methods attached to it. It also shows the validity of these tools and present experiences and future areas of development and applications for computerized tools in Kansei Engineering

3. KANSEI ENGINEERING METHODOLOGY – A PROPOSED MODEL

In 2004 Schütte, Eklund, Axelsson, and Nagamachi proposed a model on Kansei Engineering methodology. It is an aggregation of many Kansei Engineering studies and provides a structured procedure. Figure 1 depicts this proposed model.

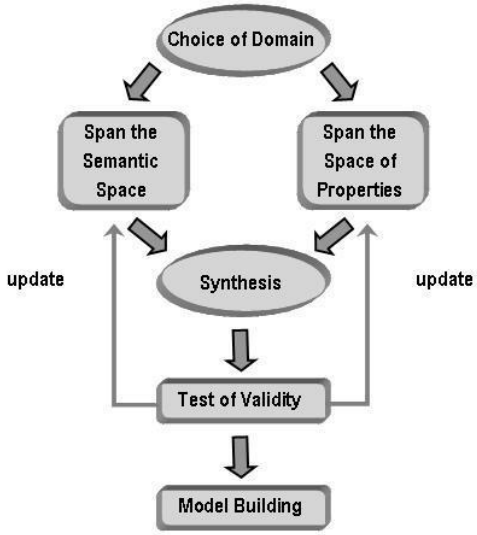


Figure 1: Kansei Engineering general procedure

As a first step, a domain is chosen. The domain definition requires customer insight information such as demographic data of the targeted user group as well as a summary of typical customer behaviour and affective customer needs. Outgoing from this, products are chosen serving this customer groups. As an inspiration, methods such as affective cards or mood boards can be used (Lee, Harada, & Stappers, 2002).

In a following step this domain, including its typical customers and products, is described from two different angles: The Semantic Space (Osgood, Suci, & Tannenbaum, 1957) and the Space of Properties (Schütte, 2005).

The Semantic Space is based on the Semantic Differential Theory of Osgood, Suci, & Tannenbaum from 1957. It is a methodology where by using Principle Component Analysis (PCA), an array of emotions are derived. This can be described as a vector representing the emotional response of

users toward a given domain. These vectors span the Semantic Space and are called Kansei Words (M Nagamachi, 2000).

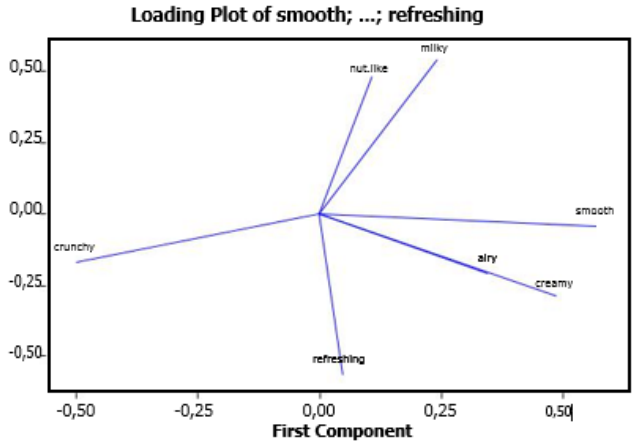


Figure 2: Example of the Semantic Space for chocolate toffee fillings (Schütte & Marco-Almagro, 2013).

The Space of Properties identifies affective physical attributes of the products in question. For this it is possible to use methods such as Card Systems or Affinity Analysis (Bergman & Klefsjö, 2002). The input to this step is a collection of products identified belonging to the earlier mentioned domain.

The output is typically a short list of product attributes that strongly affect the subjective (affective) experience of the users.

Table 1: Example of the outcome from the "Space of Application" step (Schütte & Marco-Almagro, 2013).

Sample No.	Caffeine	Flavour	Yoghurt	Spice
1	Yes	Salt	No	Chilli
2	Yes	Salt	No	None
3	No	Salt	Yes	Chilli
4	No	Salt	Yes	None
5	No	Nut	No	Chilli
6	No	Nut	No	None
7	No	Nut	Yes	Chilli
8	No	Nut	Yes	None
9	Yes	Fruit	No	Chilli
10	Yes	Fruit	No	None
11	No	Fruit	Yes	Chilli
12	No	Fruit	Yes	None

As shown in Table 1 the physical properties of the product in question are broken down into several categories. Table 1 is arranged into a so called dummy coding table. It represents 12 samples that are necessary for the following synthesis step. These 12 samples represent possible combinations of properties to be tested.

The synthesis step connects the Kansei Words (Vectors from the Semantic Space) (compare Figure 2) to the product samples representing the physical attributes of the product (from the Space of Properties). Here several methods can be used: Mathematical and non-mathematical methods. Most common methods are Linear Regression Analysis and variants of it, such as Quantification Theory Type 1 (QT1) or Ordinal Linear Regression Analysis (OLR) or even mixed effects OLR (Marco-Almagro, 2011). Other methods which are used are Rough Sets Theory (RSA) or Fuzzy logics (Nishino, Nagamachi, & Ishihara, 2001).

They all have in common that they establish a connection between the two Spaces and thereby provide a possibility for product designers to get information of how certain intended affective aspects can be represented in a product. Also, it becomes possible to choose product properties in a way that an intended feeling is supported (compare Figure 3).

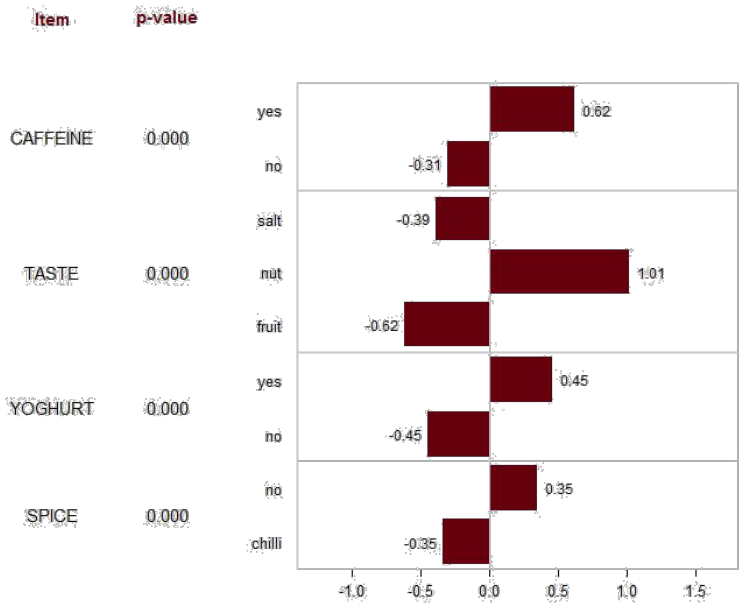


Figure 3: Example of the linking between the Semantic Space and the Space of Properties for chocolate toffee fillings for the Kansei Word "want it" (Schütte & Marco-Almagro, 2013).

Finally, a model is created, mathematical or qualitative, describing the relationship between affective aspects of customer preferences and physical properties.

This procedure is used in many Kansei Engineering studies in different variants and encourages product designers to integrate own tools and process parts from their own companies. Products which have been developed using Kansei Engineering span from cars to electronics to garments (Mitsuo Nagamachi, 1997).

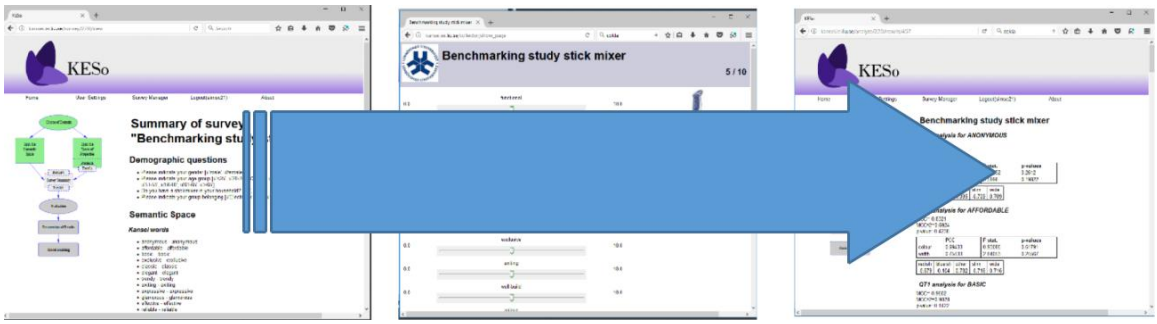
Figure 4: Samples of European Products developed using Kansei Engineering method.

In Europe, it has been used since the millennium shift in vehicle industry, food industry, construction, and furniture industry (see Figure 4). Hence, Kansei Engineering methodology is presented as a rather powerful complement in product development.

4. DEVELOPMENT OF AN ONLINE TOOL

Unlike other powerful methods such as Quality Function Deployment (QFD), Kansei Engineering never spreads as fast. As mentioned earlier, one reason for that might be that it requires a fair amount of mathematic statistical expertise. Product designers are rarely trained in those methods. Hence, Japanese researchers developed specialized systems supporting design of e.g. kitchen (Matsubara & Nagamachi, 1996, Imamura, Nomura, Tamura, & Goto, 1997). Other systems focused on integration of VR and 3D visualization (Ishihara, Ishihara, & Nagamachi, 1998, Marui, 1997) but none of those systems addressed a general purpose for Kansei Engineering studies. In the beginning of 2000 a European project was launched building an academic/industrial network and was collecting and assembling tools for affective user need assessment (ENGAGE, 2005). Within that network an attempt to a more generalized software called KENSYS was also presented. The development of this tool was however discontinued.

Schütte realized after returning from a guest researcher period in Japan in 2002 that the Japanese methods could not easily be translated and applied in European industrial contexts. This led to the development of the first version of a computerized software (Schütte, Alikalfa, Schütte, & Eklund, 2006). This software could process the synthesis step, i.e. linking together emotional terms with physical product properties using the previously mentioned QT1 method. In the 15 years since then the software is today in its 5 generation and an online tool which is available for free on www.kanseiengineering.net.



Survey creation Data collection Data evaluation

Figure 5: Typical KESo procedure. Source: www.kanseiengineering.net

KESo software is a universal tool for Kansei Engineering studies. It is built around the general Kansei Engineering model from 2004 (Figure 1) and follows its structure. After defining the domain, both

Semantic and Physical Space an online survey is created as illustrated in Figure 5 left. The created survey (middle) is then put online, and answered by suitable users. This can be done by simply posting an online questionnaire to the participants including images, videos, or sound files of the product in question. If other properties are supposed to be evaluated, the questionnaire can be carried out in a lab environment on mobile devices. If necessary, the data can even be collected manually on paper and input in the system later. When the data collection is finished (or even while collection data) the data can be analysed in the synthesis step using a different statistical tool. Today KESo can evaluate data using QT1, OLR, and RSA (compare section 3).

5. EXPERIENCES WITH ONLINE TOOLS

The evaluation of online tools in Kansei Engineering is almost solely based on the authors' experiences with KESo software and its derivatives. Hence, the authors are aware that the picture they are drawing in this paper can be somewhat biased. On the other hand, the authors tried to draw their conclusion on a meta-level without too much focus on the special functionality

Companies usually embrace tools for affective evaluation of their products. There are very few documented and tested methods and tools on the market. That does by no means mean that there is no need for such methods. Rather companies working in tough markets see their work and knowledge on affective aspects as their competitive edge. Therefore, most of them are uneager to share that knowledge. Computerized tools have always been a welcome addition to their development arsenal, either for application in their actual R&D activities or just for verification of their own work.

A great advantage of tools such as KESo (as many other tools aiming for usage in R&D) is that it can seamlessly be integrated into companies product development processes. This makes it easier for product designers to relate to the tool and reduces the mental threshold to actually applying it to real world problems. Also, as mentioned earlier, online tools are simple and intuitive to use. This reduces the necessity of gathering additional knowledge of areas not directly related to product development activities – in the case of KESo: mathematical statistical familiarity.

As reality looks like today, many bigger companies within B2C branches consider right affective appearance of their products as mandatory. Vehicle industry, furniture producers, and service providers have specialized staff for this purpose. SME:s however, do certainly see the advantage of having products affectively streamlined, but they often do not have the financial means and expertise to do so. Here a more generalized tool like KESo can make a difference for R&D process in SME:s.

From a scientific point of view the online tools have promoted the area of affective product development research. Cooperation between companies and academia in the area of Kansei Engineering could prove its strength as a methodology and the tools showed their function in real life environments. Many products (compare Figure 4) in the world demonstrate this.

However, there are also risks involved when using tools like those presented in this paper. As previously mentioned as an advantage, tools like KESo are developed to be simple and intuitive to use. The risk however, is that such tool used by unexperienced designers, can return false data (e.g. as a result of bad input data quality). Due to the lack of experience, the designer might take wrong

outputs as real and draw wrong conclusions. Also, results are statistical in nature. In other words: The data is true for only a part of the customer group. Engineers, however, sometimes tend to over-interpret the results taking them as absolute truth. In fact, the outcome from Kansei Engineering studies should be handled as a support for further product development. These tools do not automatize a designer's decision-making.

6. FUTURE DEVELOPMENTS

Despite the success affective evaluation software had in the past, there is still a lot of improvement potential. One is closely related to the previously mentioned ease of use. Of course, affective evaluation software needs to be intuitive and must require little expert knowledge on the statistical methods behind it. On the other hand, it must be ensured that everybody can determine the quality of the resulting data. One way could be an improved dashboard or colour coding of results that are statistically less reliable.

Since Kansei Engineering is expanding fast, new tools for the different steps in Figure 1 are developed. Testing them manually would be cumbersome. Therefore, the software should be designed to include new experimental tools easily. That would decrease development time and validation of new tools. Moreover, the software would become more universal.

Another aspect which would make affective evaluation software more universal would be to enhance the ability to integrate it with existing R&D systems such as SAP. Being able to display data in other system would further lower the threshold for usage of those systems.

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