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An Evaluation of the Statistical Techniques Used in Kansei Engineering Studies

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Abstract: Kansei engineering is a field in which development of products that brings happiness and satisfaction to humans is performed technologically. Many well-known statistical techniques are widely used in kansei data analysis. These techniques include multivariate statistical techniques like such as principal component analysis, factor analysis, cluster analysis, regression and correspondence analysis. The use of statistical analysis in kansei studies is very important. Particularly in the kansei process, after the data are collected, the data are primarily confronted in the analysis phase. Studies on Kansei engineering are made in many areas, for examples in automotive, food and furniture industries and so on. Especially in the product design process, we can use statistical techniques for obtaining kansei data and analyzing data. The kansei applications are designed to establish the relationship between customer image and design characteristics of products. A questionnaire used to reveal the kansei words. Feelings and emotions associated with the product design. The statistical analysis is used to select the kansei words after the selection of the words and the application of a specified sample client. In this study, we will explain what statistical techniques are used and how to use them in kansei studies.
Keywords: Kansei engineering; Statistics techniques; Product design.

INTRODUCTION

Kansei Engineering was founded at Hiroshima University and since then more than 30 new products have been developed using Kansei Engineering. All Kansei products sold well and made a lot of profits the manufacturers [1]. Since Kansei Engineering was developed in the early 70's an increasing number of universities and companies have adopted and implemented the method [2]. Today, there are many people working with Kansei Engineering. Employees are located in companies and universities. Works in this area take place in cooperation with employees in different fields such as engineers, designers, economist, psychologists, sociologists and statisticians. One reason for this distribution is the complexity of the methodology, which requires close co-operation between companies and universities [2]. It can be said Kansei Engineering is a multidisciplinary working area. It can be seen Kansei applications in many sectors. It is also possible to see scientific researches in these areas. For example; Mamaghami *et al.* [3] worked on consumer's perception of the ketchup sauce bottle. Yin & Gan [4] made a paper related to texture design methods of clothing material. Yodwangjai & Pimapunsrik [5] used one Kansei application in furniture design. Erdoğmuş *et al.* [6] studied evaluation of popular web portals in Turkey based on user's feelings.

Kansei engineering is a technology that unites Kansei (feelings and emotions) with the engineering discipline. It is a field in which the development of products that bring happiness and satisfaction to humans is performed technologically, by analyzing humane motions and incorporating then into product design [7]. Innovation and quality are needed to meet customers' expectations. Expectation is emotion as can be easily understood if we recall that the word motivation or motive comes from the same Latin word "movere" as emotion does. Engineering is an activity of creating artifacts that are not available in nature. It is an activity to realize our dreams. So it may not be too much to say that engineering itself is an emotional activity. Innovation and pursuit of quality come from our basic human nature and it is very much related to our emotions. Thus, innovation becomes true innovation when it meets the expectations of customers and when they feel they have new innovative products. It is very important to measure customer expectations to design a new product and develop an existing product. Kansei engineering is interested in with customer's emotions and feelings [8].

Kansei engineering tries to produce a new product based on the consumer's feeling and demand. There are four points concerning Kansei: (1) how to capture the consumer's feeling (Kansei) about the product, (2) how to determine the design characteristics

of the product from the consumer's Kansei, (3) how to build Kansei engineering as an ergonomic technology and (4) how to generalize this context (adjust product design to the current societal change or people's preference trend) [9]. Statistical analysis has an important place in the two of these four points related to Kansei Engineering. In this study, it was aimed to emphasize the importance of statistical analysis within Kansei procedure.

KANSEI TECHNIQUES

Kansei engineering techniques have been classified into three: Type I, Type II and Type III. Kansei engineering Type I am the easiest to understand and introduce. Type I deals with product concept. The sequence for the Kansei engineering Type I start with breaking down the concept and reflecting it into a design's physical characteristics. Then comes the translation of physical characteristics into technical specifications. Kansei engineering Type II is similar to Type I. The Kansei engineering Type II is a technique of translating the image or Kansei of a product that consumers hold in their minds into tangible product design elements. The process that starts with a Kansei study and then is reflected in physical design characteristics is also the same in Kansei Engineering Type III. The difference is that in Type III, a mathematical model is mediated, and the relations from input to output (physical characteristics) are established by finding the coefficient value [7].

Thinking statistical analysis in kansei

It can be shown Kansei Engineering procedure For Type II in Fig-1. This procedure needs to use statistical techiniques. First step starts with selecting survey target. W e have to use sampling procedure for selecting survey target. Multivariate analyses play principal roles in Kansei engineering [10]. Kansei evaluation data have multidimensional characteristics because the nature of Kansei is multidimensional. It can be used in many multivariate statistical techniques in this procedure. Among the multivariate statistical techniques, it is possible to count as follows:

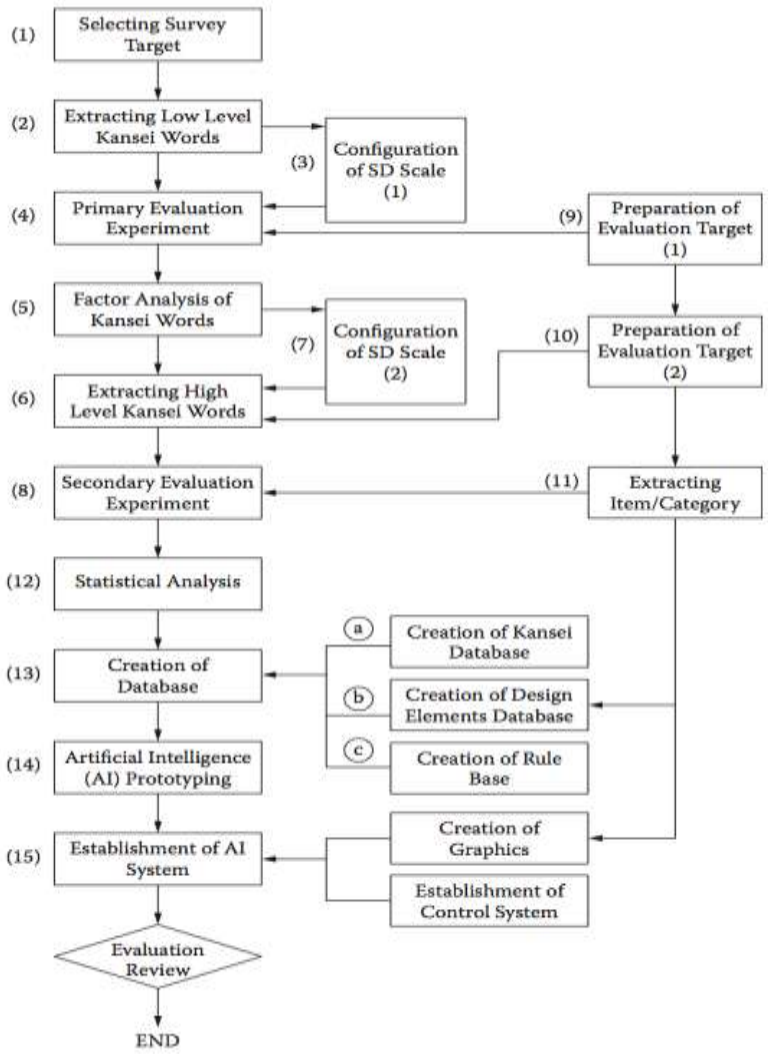

Fig-1: Kansei Engineering Type II procedure [7]

Cluster analysis can be used to reduce the initial semantic space (the initial set of Kansei words) into a more manageable set of responses. Factorial designs are used when spanning the space of properties for choosing the set of products to be rated by participants in the data collection. Regression models are used to link the space of properties (the factors) and the semantic space (the responses) in the synthesis phase. Also it can give regression techniques like multivariate regression, logistic regression Principal component analysis can be used to locate Kansei words (the responses) on a scatterplot with the first principal components, so showing which responses are perceived similar [11-13].

When it is used in multivariate analyses in Kansei engineering, it is often taken the following steps:

i. Principal component analysis is used to obtain Kansei structures. Multidimensional scaling method and factor analysis are also used in some events.

ii. Cluster analysis classifies samples as groups with similarity of their evaluation. From the results, it is obtained the sample clusters, each of which has a different decisive design structure. The neural network-based method performs more precise clustering than traditional algorithms.

iii. To obtain relationships between Kansei and design details, many analyses will be tested to determine what type of appearances and functionalities are produced for Kansei information. In most cases of Kansei engineering, the design elements are expressed as categorical variables. Then, it is used quantification theory Type 1 (QT1) for analyzing relationships between Kansei evaluation and design elements. QT1 is a variation of regression analysis that deals with continuous variables. QT1 deals with categories for explanatory variables. Often in cases of real product development, we proceed with a huge number of design elements too many to analyze using general multivariate analyses. It is used the partial least squares method in such cases because it can process a larger number of explanatory variables in the model.

iv. Local regression method is used to take account of nonlinear relationships between design elements and Kansei evaluation in the statistical model. This is a useful tool for visual investigation of uneven local relations between variations of a design element and Kansei evaluation.

v. It is used correspondence analysis or quantification theory Type 3 to map the variations of the design element to visualize the results. The local regression method used with these analyses provides three- dimensional representations of relationships between design and Kansei evaluation.

CONCLUSIONS

Kansei Engineering is a methodology to discover the emotions and feelings elicited by different product design characteristics ; the methodology relies heavily on data and statistical tools [14]. Even if statistical analysis is used, if it is not used correctly, it will lead us to the wrong results and it will affect the decisions that will be given depending on these results. Depending on statistical analysis decisions, new product designs to be made or changes to existing products will be affected.

In Kansei process it is very important to decide which statistical technique is necessary. It is also important to use the right technique at the same time. The selected statistical analysis techniques and the correct use of them are important. It is also important that the results obtained from the statistical analysis are correctly interpreted and that the correct decisions are made about them. Statistician's co-operation gains importance in kansei engineering, which is an interdisciplinary approach.

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