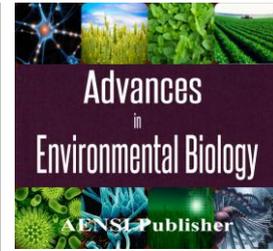




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Developing an Integrated Model to Improve the Performance of Kansei Engineering by PCA and TOPSIS

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ABSTRACT

Nowadays, products must be designed in order to respond users' demand and desires. Several methods are used by designers to design products. Among these methods, we can mention kansei engineering that attempts to determine product features based on customer feelings. This method accomplishes it by placing customer in real space of product. In this study, in order to evaluate sofa features the mood board method has been used as case study. Therefore among various designs of sofa, three of them were selected based on technical differences and evaluated by 58 adjectives. By using factor analysis, these words placed under nine equal factors for each sofa and then ranked with TOPSIS method and superior design had been selected. With the help of this study users feelings are translated in ranking sofas.

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INTRODUCTION

Increasing technology, the move toward globalization, the decline of state monopoly and the existence of informed employees and customers are the vital factors that play an important role in determining the future business model. Due to the changes associated with factors such as product management, marketing, and customer research and development activities, to coming over the conditions organizations are needed to apply some modifications that are necessary in these areas. Development of customers-focused organizations and existence of persuade, informed and selector customers instead of convincing customers and shortening the design process rather than long design process and development of products, are the new trends in organizations to achieve organizational goals [24] Thorough understanding producers of the spiritual, cultural, social, technological, ethical needs of client, thereby will producing goods more attractive to consumers, sales rates will increases and manufacturers will notice the tremendous economic and social success.

Generally, emotions are the result of external motivation that perceived by human senses and influence on their minds, this sensory information is purely objective and by processes of the human mind are become too emotional reactions. Kansei engineering is a way to convert the feelings and emotional impact of the parameters, was created by Professor Mitsuo Nagamachi, head of Hiroshima International University, in the 1970. This method of measuring the various emotions and their relationship to the actual production characteristics show [1] in fact Kansei engineering methodology is to design and develop a product that translates a man's feelings and needs regarding the products, to solutions and design visual elements. Psychological feelings (including emotions, moods, perceptions, etc.) are collected by an appropriate method (e.g. semantic deductive method). The data used to construct the knowledge database by the statistical methods. This database used for the link between emotions and physical characteristics of the product. So how to choose the physical characteristics and product attributes on the perception of the whole product is very impressive. One of the main differences Kansei engineering methods with other methods is that it is trying to put customers in a product space, breaking out of his/her emotional needs and use it to design the ideal product. The ways that are mainly used to breaking out the customer's emotion are include: Cooperation and thoughts together, create mental cues in user, creative activities; use of images is used to express a feeling.

In this study, we tried to carefully review and evaluate the various theories of Kansei engineering background studies, methods of extraction and emotion recognition based on its users, an emotional vocabulary

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is presented in conjunction with the sofa. So first by the comprehensive review of the research literature, collection methods and the comprehensive identification and semantic space based on the selected methods for making categories of organized present furniture most vocabulary emotional are created. Then a questionnaire to assess risk factors based on the use of images to express emotion, designed and delivered to the sample to complete. Thereby Intellectual backgrounds is create and let he/she be in a space where he/she obtained easily, and imagery his/her needs and breaking out the aspirations and feelings. Then the analysis was performed to analysis of emotional words and put them in the same groups. These factors were considered as the basis of the decision matrix, and TOPSIS method is proposed to prioritize the projects selected furniture.

1- Literature:

Jindo and Hirasago in Japan began to study the characteristics of car interiors (Speedometer and steering). Analog Speedometer components were evaluated and 23 plans was created. Then, 8 pairs of adjectives by 23 subjects were evaluated and with factor evaluated analysis the most emotional words "easy to understand" and "luxury" were identified. A similar procedure was also performed for the steering wheel and the words "comfort" and "sport" being identified as the most important words. In a study that was done by Nakada on the chair lift operator in Japan 349 adjective pairs collected from various sources and by expert opinion declined to 19 pairs of adjectives and by using factor analysis were finalized in the five factors [13].

Jiao, Zhang and Helander tested the application of their proposed Kansei system in the emotional design of mobile phones. 15 adjective pairs and 23 component design based on previous studies were used in this study. The restraint system has three bases: Kansei words, design elements and transactions, the main work are on transactions base that allow the customer to choose the best plan from their pointof view [12]. Linares and Page (2008) suggest that to assess the emotional perceptions of citizens and by the semantic differences method their impact on the neighborhood selection has been determined. According to Kansei methods, in order to properly assess the situation, 100 men and 59 women expressed their opinions about different neighborhoods in the city of Valencia (Spain). By using dependence diagrams and factor analysis 142 Kansei words were chosen [17].

Dehlgard, Schutte and Ayas, study in Sweden with the aim of discussing the Kansei engineering methods. This study was conducted to improve the taste and appearance of chocolate. The 9 words were collected by using the factor analysis [7]. Lanzotti and Tarantino, have been defined a structured process of continuous innovation in product concept development phase, by Kansei engineering based on statistics. Have participated in this study, 20 trains passenger and 39 local projects were identified related to emotional words. Factor analysis and classification of diagrams have been used to reduce and classify these words in five words. [15]. Ayas, Eklund, Ishihara study a framework model to identify the emotional values of service areas statements. They were looking for emotional design of the waiting room of hygiene facilities. Study was done in six health centers in different areas of Usterl and in Sweden with different cultural contexts, as well. Totally, 88 subjects (60 patients and 28 staff) were interviewed. Free extraction methods were used to collect data. Thus feeling a sense step up from different locations and important intuitions about the next stage was recorded. Then three types of classification quality and technique of correspondence analysis to put in the waiting rooms of quality dimensions were used. Relationship between design features for the desired emotion was analyzed by the ROSE software and rough set analysis [5].

Lokman and Nagamachi have been created an approach to design an affective e-commerce websites using Kansei engineering. For Semantic evaluation of online Web sites, 120 participants were asked to rate the 35 pre-selected clothing online website using Kansei checklist that contains 40 pairs of adjectives with 5 step scale. Reliability of the checklist was calculated using Cronbach's alpha [24].

Wang, Yan Chen and Zha Chen study the women's overcoat and try to understand the relationship between emotional words and the design of the features product. In this respect, they collected emotions traits, and 180 pairs were identified. Cards systems were used to reduce these attributes. Words are classified in 45 group by the experts and the clothe designers, then again, these groups were classified according to the degree of closeness to six groups and from each group one adjective pairs were selected as representative of that groups. These words include the feminine, fashion, formal, simple, unique and had a pop teen [26]. Ishihara.k, Nakagawa, Ishihara.sh and Nagamachi study on the relation with the people feeling and choosing the flowers. In this study, 25 different types of flowers were chosen and were rated by 10 men and women using 57- emotion word. Then, with the principal component analysis, the words were placed on the dimensions and their connections with flowers were studied. In the study, researchers looked at their most ideal method of picking flowers [14].

Hong and Nieh study the city restaurant front ages of Tichangin Taiwan. Their goal is to extract an architectural characteristic of the view of the restaurant so that let a more customers to eating and going to get it. In order to view this, 16 restaurants were selected and by 57 individuals that using 20 adjective pairs were scored. Using principal component analysis of the main photographs were identified [10]. In a study that Lookman and Nagamachi for Emotional design of business website was made, 163 dress websites according to their difference were selected and after analyzing them 35 websites were selected. The 40 emotion word was

collected from various sources, and checklist for ranking the web sites is designed. Using analysis were summarized principal component of these words in the fourth dimensions, the first two had the greatest impact. At the end, the exclusive features of websites were studied associated with the selected words [19]. At Tolouie and Alnachry study Kansei engineering and quality function deployment method are used to evaluate the characteristics of women's watches. In this regard, at first from 1350 women's wristwatch, 100 watches were selected based on differences in form. Then, 22 physical characteristics design are defined for watches. 100 watch on the bases of defined typical features and are divided into 10 groups with the clustering method. From each group one agent that has the highest specifications is chosen as the representative for the study. To identify the emotions of users, 150 words collected from various sources and using factor analysis has been reduced them to 12 words. Data analysis confirms a direct relationship between product characteristics and emotions of the users are exist [30]. Khodadadeh and Tolouie study Kansei engineering methods for motor design for older people have the means to help. Words Gathered designers fell to 24 words. 52 patients were studied and the results of research and analysis conducted on four selected projects, final design features were identified [2].

What is seen in most studies, researchers have focused on the first part Kansei engineering, i.e., extracting, and less emotional factors associated with these factors in the design and product selection are discussed. Although researches in this area have been mentioned on this section but it was mostly based on intuitive reasoning. Choose words from the vocabulary of product design or non-systematic factors are Kansei. Emotional words can be helpful to primary literature mining. In addition, this study also interviewed face attributes with different people in different age groups in the city of Mashhad came to a complete content analysis of acquired traits through interviews, background research and a table (1) is.

Table 1: Attributes used in the questionnaire.

Nobility- commoner .[28].[24].[23].[10] Chic-Doric .[23].[24] Attractive-boring .[11].[24].[5].[13] Fashionable-out of fashion .[12].[24].[17].[19] Special-common .[27].[19] Modern-traditional .[3].[11].[9] Impressive-non impressive .[3] Tinsel-banal .[3]	Group1 .[13].[3].[24].[23]
Funny-not funny lovely-non lovely.[3] Delicate-physique .[13].[23].[3] Soft-rough .[29].[3].[28] Natural-artificial .[28].[11] relaxing-non relaxing.[19] Positive-negative .[23].[5] exciting-non exciting.[5] Good taste-bad taste .[23].[5] .[24].[2] beautiful-ugly. Colorful-discoloration .[11].[18].[10] .[16] Artistic-folk romantic-non romantic.[10] good model- bad model.[18]] .[interview] young like-elderly like fantasy- non fantasy.[15] feminine-muscular. [16] .[14].[28].[9]	Group2 .[13].[26].[5].[19]
Symmetric- asymmetric regular-irregular. [10] larger than usual-smaller than usual. [17] light-heavy.[interview] Sport-non sport .[7].[14] Clean working- non clean working .[7].[13] Functional-decorative.[interview] efficient-inefficient.[23].[29].[11].[27] formal- in formal. [3]	Group 3 [(1387)Toloo.(2011)Yang.(1997)Nakada.(2009)Hangoonie] .[23].[28].[11].[3]

.[16]·[18] Moveable-non moveable dynamic-static· [14] match-mismatch·[15] horny-loose· [22] elastic-inelastic· [29] ◁[interview] big- small multi functional-single function· [17] ◁[interview] Washable-non washable wide-narrow·[interview] long-short· [20] .[20]	
◁National-overseas[interview] Factory made- workshop made ◁[interview] Solitude-crowded ◁[19] Complicated-simple light-dark·[29]·[19]·[11]·[14] .[14]·[11] Urban-rural .[14]·[10] Branded-un branded· [11]inexpensive-expensive ◁[interview] alive-dead Permanent-non permanent .[17]·[10] mature-raw· [2] .[16]·[21] Designed-non designed Innovative-Imitative· [17] ultra modern-elderly· [28] [10]	Group4 .[22]·[19]·[9]·[29]

2- Research Methodology:

3-1 Community, Statistical sample and data collection:

The aim of a present study is based on the applicable type of survey - analysis. Unit of analysis of this study is, all of the unknown community potential Sofa buyers in Mashhad. In some Researches information that should be reviewed and analyzed as they are prepared. Therefore, in this study, a questionnaire designed to identify emotional words, the information and evidence, including a review of the entire record and unbiased research in the field of engineering Kansei was used. Also to identify the words, a sample of clients was interviewed face to face and these people were selected through convenience sampling. Thus, the number of vendors and customers of furniture were asked some questions in connection with the feelings and expectations of the sofa and some vocabulary were obtained. The selection process of samples continued until enough emotional words were obtained. The population samples of the ideas presented were used for grouping words. Cochran's sample size formula (in the indefinite and uncertain) was calculated by the following formula 1:

$$n = \frac{pqz_{\alpha/2}^2}{e^2} \quad (1)$$

The formula parameters are: $e = 0.07$, $\alpha = 0.05$ and $p = q = 0.05$. Based on these parameters a sample size of 100 was obtained. The distribution of the questionnaire was conducted presence and online by email. 120 questionnaires were distributed and collecting them continued to achieve 100 questionnaires, and the rest of them due to lack of acceptance by the respondents, did not return incomplete and not reliable, were not used so the response rate was 83%.

3-2 Questionnaire design:

Since there is no standard questionnaire on emotional sofa factors, in this study a researches' questionnaire was used. Questionnaire as the most commonly used means of data collection in survey research. For designing the questionnaire following steps were done: In the first step to identify key words related to the emotional needs of our customers comfortable furniture, which includes information from the literature and listed in Table 1 were used along with interviews with clients. The number of characters that were extracted was 97 pairs of trait. Then, according to the definitions of these attributes and interviews with a number of experts in this field to identify the same attributes, 58 distinct definitions traits were selected. The coupling characteristic of the questionnaire was based on design. In kansei engineering different techniques used to put a person on the product space and understand his/her hide feelings and needs, including the use of techniques of simulation, virtual reality laboratory, instantiated the product, techniques of external breaking. Ways that are mainly used in

Breaking out qualitative sense are include: a seminar Cooperation and create mental cues in user, creative activities and use of images is used to express a feeling. During the study, the method of images is used. Images are powerful resource for expressing meaning and emotional experiences that allow tools to find the words. Represented mood board techniques (1) is one of these tools of a method that with a set of images help to analyzing, create and foster creativity ideas. This tool by delaying all the thoughts in time and start creative thinking has a better usage in motivating and analyzing feelings and perceptions in pursuit of momentary than form, color, etc. The construction of mood boards are shown generally to represents a combination of images pasted onto a page or foam for men. Objects can also be used so in this way a Creating mood board starts with sentence or phrase as the target and initial shocker. In designing of Creating plate's mood abstract images are recommended because they do not represent a more direct expression of and communicate with the inner feelings of Users. One of the advantages of this tool is the lack of limitations to a specific language, because the only thing people are dealing with are images [8]. So at this stage, we interviewed a number of experts and designers using the furniture industry and furniture magazines, catalogs Sites interior decoration and design of furniture and specialized furniture was achieved overall classification. Three photos from this category of sofas were selected in questioner. The origin of these designs related to Turkish and Iranian furniture company show in figure (1).

In the final stage, the selected plates are used to emotional assessment of furniture. Sofa photos were selected in color printing for the questionnaire. Respondents were asked to announce their opinion about the each furniture in Likert scale of 7. This spectrum were designed so that in the two ends of the spectrum opposite traits were placed and the respondents with the feelings toward the sofa, would mark one of the options, 30 of the questionnaires were shared face to face to the first sample that includes some sofa sellers and student, and asked them to tell their ideas about the traits to the researchers, so decide about identically of what the researchers idea and what the sample opinion and tried to discussed about everyone opinion.



Sofa3: L shape combined sofa

Sofa2: modern leather sofa

Sofa 1: Classical Fabric Sofa

Shape 1: Sofas used in the study.

3-3 Reliability and Validity:

In this study content analysis were used in both formal and rational way, so before the designing the questionnaires book, essays and previous research were read and checked to find the emotional vocabulary. Also interviewed with some clientele and some word are found from them. Yet every step of designing the questionnaires is checked and confirmed with expertise of the sofa industry. More, the final questionnaires shared in the 30 of clientele and expertise experimentally and after the feedback of them, content validity of questionnaires was calculated.

Test reliability of the questionnaires was carried out with the re test and Cronbach's alpha reliability, and the results are expressed in Table 2. As can be seen alpha values calculated for the three plans is higher than 75%, which is an acceptable value. Also with using representation method at different times (within two months) under the same conditions from 20 subjects' respondents was re-tested. After re-test the subjects' scores, correlation coefficients were calculated.

Table 2: Results of the Alpha Cronbach and retest.

Sofa design	Cronbach's alpha	Spearman correlation coefficients
1	0.88	0.76
2	0.93	0.83
3	0.94	0.89

3-4 Analysis method:

In the first phase of this study, exploratory factor analysis was used for classification of characters. In exploratory factor analysis researcher was tried to find the fundamental basis of a large sets of variable and the basic assumptions of the researcher, is that any variable may be associated with each factor. Researchers in this

method, have no initial theory. In factor analysis, the problem must first ensure that existing data can be used for the analysis. In other words, the numbers of data are suitable for factor analysis or not? For this purpose, the KMO index and the Bartlett test is used. The KMO index is the adequacy of the sampling that tested the minimal solidarity of variables and from this way it shows whether the variance of the research variables are influenced by the same variance of some basic and hidden factors. This index is in the range of zero to one. If the index is near to one, the data are suitable for factor analysis and if the index is low (usually lower than 0.5) result of factor analysis is not suitable for the data. Bartlett test examines, whether the correlation matrix is known (from a mathematical point of view, identity and unit matrix) and thus it is inappropriate to identify the structure (pattern factor). If the sign of Bartlett test is less than 5% Factor analysis is useful for identifying structure, because the assumption of known correlation matrix is rejected. The analysis was done by using statistical package for social sciences (SPSS v.16). These two tests were examined for each group vocabulary separately and the results are given in the next part. In herent Factors in the test was obtained by the, principal component analysis method (2). Interpretation of factor loadings without rotation is not easy. So start to rotate the factors to increase their interpretation ability. The greater the absolute value of these loads, the greater role the related factor has in the total variation (variance) of desired variable. So to put words under the factors, the rotated factor loadings were used. Attributes that have been studying in the history are gathered in a group (Table 1) and were analyzed, each group became into two or three factor. After the factor analysis was conducted on three form of furniture, Either in terms of the number and attributes placed under factors, there was a non-quantitative similarity (or no party bit) between three sofas. So it was decided that to remove these trivial non-quantitative similarity among the same factors of the three projects, in some cases words with the highest multiplicity in one factor, is not only placed in that factor, and with the multiplicity of higher than 0.3 used for allocating to other factor. Thus, we can name the same factors and use them in the paired comparisons matrix. Since we decided to obtain the same factors for various sofas, in only one case (Group 1 vocabularies of sofa 2), the primary analysis was led to one factor, we entered the desired number of factors (which was 2 factors) to the Software.

Given that the measures announced by the needs of our customers and in the previous analysis, only using a Likert-grade has been calculated for the comparison of them, Secondly need of an expert look to the emotional needs along with possible solutions by decision-making matrix is formed and by using the Shannon entropy, weights 9 criteria (factors) along with 3 fields (design furniture) is calculated. Entropy represents the amount of uncertainty arising from the content of a message. In other words, entropy is expressed a measure for the measurement uncertainty by a probability distribution. The method is based on the variance of the values of an index, more variance the index has, more the index important.

Finally, in order to provide a scientific and practical approach for applying best designs, in order to cover the needs of the client cache, multiple criteria decision making procedure and a decision making matrix, according to research approach, interactive optimization model (3) was chosen. According to conclusion part of literature review, It can be claimed that the use of multiple criteria decision making approach in the study of innovation Kansei engineering approach to product design choices. TOPSIS method for each alternative in the form of points in n-dimensional space ($n = \text{number of criteria}$) are considered, then two virtual alternative, namely the positive ideal and negative ideal are defined. Positive ideal alternative are the answers that are the best in all criteria and negative ideal alternative are the answers that are worst in all criteria, The Euclidean distance between individual schemes to the tow above ideal alternative were computed and schemes that simultaneously with the closest distance to positive ideal and farthest distance from the negative ideal, are selected as the best schemes. So the ideal solution would be easily identified.

4- Result:

4-1 Grouping emotional words:

The possibility of factor analysis on a sample, using Bartlett's test of sampling adequacy index was investigated. For the first Group of schemes one and three, percent confidence of Bartlett test was 0.000 and sampling adequacy index were 0.79 and 0.85 respectively. Words of scheme of one from second group are become in one factor in order to coordinate with other agents in other schemes, in software number of factors are written 2 and the confidence percent of Bartlett test was 0.000 and sampling adequacy index was 0.85. First factor named as "luxury" and second as "up-to-date". Factors are reported in table (3).

For groups of 2 characters, in order to reducing agents, and raise indices, some attributes include the feminine, elegant and fantasy was eliminated. So Bartlett percent confidence was 0.000 and sampling adequacy index for each of the three designs were 0.78, 0.87, 0.88, respectively. First factor as "emotional" and the latter as "delightful", were named respectively. Factors are reported in Table (3).

In the third group of characters, after the elimination of efficient, flexible, multifunctional, firm, sporty and long, Bartlett percent confidence was 0.000 and sampling adequacy index for each of three schemes were 0.77, 0.71 and 0.58 respectively. First factor as "good style", second as "moving" and third as "dimension" were named. Factors are reported in Table (4).

Table 3: Factor loadings of final elements in groups 1 and 2 the emotional words of sofa 1, 2 and 3.

Group 1 variables	Sofa1		Sofa 2		Sofa3	
	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2
Special-common	0.77		0.74		0.51	
Nobility-commoner	0.77		0.78		0.84	
Tinsel-banal	0.73		0.53		0.69	
Impressive-non impressive	0.6		0.36		0.8	
Modern-traditional		0.82		0.87		0.74
Attractive-boring		0.65		0.88		0.84
Chic-Doric		0.6		0.85		0.84
Fashionable-out of fashion		0.56		0.79		0.9

Group 2 variables	Sofa1		Sofa2		Sofa3	
	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2
Lovely-not lovely	0.71		0.68		0.83	
Funny-not funny	0.57		0.56		0.73	
Relaxing-non relaxing	0.55		0.82		0.77	
Natural-artificial	0.54		0.58		0.59	
Positive-negative	0.54		0.78		0.62	
Beautiful-ugly	0.53		0.79		0.65	
Soft-rough	0.47		0.79		0.87	
Exciting-non exciting	0.36		0.7		0.46	
Good taste-bad taste		0.79		0.83		0.5
Good model-bad model		0.77		0.71		0.64
Colorful-discoloration		0.66		0.34		0.33
Romantic-non romantic		0.58		0.73		0.84
Young like-elderly like		0.56		0.83		0.83
Artistic-folk		0.52		0.62		0.61

Table 4: Factor loadings of the final elements in groups 3 and 4 emotional words of sofa 1, 2 and 3.

Group 3 variables	Sofa 1			Sofa 2			Sofa 3		
	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3
Symmetric-asymmetric	0.68			0.64			0.45		
Regular-irregular	0.67			0.7			0.75		
Clean working- non clean working	0.66			0.65			0.78		
Formal- in formal	0.62			0.51			0.32		
Washable-non washable	0.55			0.3			0.36		
Functional-decorative	0.42			0.75			0.64		
Moveable- non moveable		0.8			0.8			0.52	
Light-heavy		0.77			0.56			0.39	
Moveable-constant		0.67			0.77			0.74	
Big-little			0.75			0.75			0.83
Larger than usual-smaller than usual			0.72			0.3			0.64
Wide-narrow			0.69			0.65			0.76

Group 4 variables	Sofa 1		Sofa 2		Sofa 3	
	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2
Urban-rural	0.73		0.72		0.74	
Ultra modern-ageing	0.64		0.55		0.59	
Innovative-Imitative	0.43		0.47		0.52	
Alive- dead	0.4		0.63		0.77	
Complicated-simple	0.41		0.66		0.3	
Solitude-crowded	0.34		0.59		0.74	
Mature-raw	0.3		0.44		0.3	
Branded-un branded		0.73		0.59		0.86
Factory made-workshop made		0.51		0.54		0.88
Permanent-non permanent		0.3		0.42		0.39

In fourth group of characters, after the variables internal, light and inexpensive, the Bartlett percent confidence was 0.000 and sampling adequacy index for each of three schemes were 0.69, 0.63 and 0.64 respectively. First factor as "affect" and second as "credit" were named. Factors are reported in Table (4).

4-2 Determine the importance of extracted emotional factors:

In order to offer a dominant scheme, the average of factor for each factor were used, these averages are presented in the Table (5), furthermore, the Shannon entropy method was used to evaluate the weight of the factors.

Table 5: Average of the sofa designs.

validity	effective	dimensional	Movable	Style	delightful	emotional	Up to date	luxury	Factor/variable
0.51	0.46	0.72	0.75	0.6	0.65	0.53	0.66	0.72	Sofa1
0.52	0.58	0.57	0.71	0.59	0.68	0.71	0.85	0.6	Sofa 2
0.71	0.57	0.74	0.55	0.55	0.63	0.69	0.83	0.71	Sofa 3

All the columns in the table was normalized with the formula (2), by following the Shannon method the uncertainty index was calculated by the formula (3) for all the columns. For the certainty indexes used formula (4) and for calculating the weight of the factors used formula (5), results are shown in Table (6).

$$P_{ij} = \frac{x_{ij}}{\sum_{i=1}^m x_{ij}}, \forall i, j \tag{2}$$

$$E_j = -1/Lnm \sum_{i=1}^m p_{ij} Lnp_{ij} \tag{3}$$

$$d_j = 1 - E_j \quad (4)$$

$$W_j = \frac{d_j}{\sum_{j=1}^n d_j} \quad (5)$$

Table 6: Calculate the weights.

validity	effective	dimensional	movable	style	delightful	emotional	Up to date	luxury	
0.843	0.904	0.710	0.717	0.862	0.759	0.761	0.516	0.716	E_j
0.157	0.096	0.290	0.283	0.138	0.241	0.239	0.484	0.284	d_j
0.071	0.043	0.131	0.128	0.063	0.109	0.108	0.219	0.129	W_j

4-3 Ranking the sofas schemes:

TOPSIS method was used in the following steps in this research, and appropriate scheme according to emotional quality were selected.

First step: decision matrix with the oghlidosi system was normalized in Table (7).

Table7: Normalized Matrix.

validity	effective	Dimensional	Movable	style	delightful	emotional	Up to date	luxury	Factor/variable
0.29	0.29	0.35	0.37	0.34	0.33	0.27	0.28	0.35	Sofa1
0.3	0.36	0.28	0.35	0.34	0.35	0.37	0.36	0.3	Sofa2
0.41	0.35	0.36	0.27	0.32	0.32	0.36	0.35	0.35	Sofa3

Second step: weight of each criterion was multiple by same column of that criterion in the decision matrix and non-meter weight matrix (V) were evaluated. Results are shown in Table (8).

Table 8: Obtained matrix from multiplying the normalized weight vector.

validity	effective	dimensional	movable	style	delightful	emotional	Up to date	Luxury	Factor/variable
0.021	0.013	0.046	0.047	0.021	0.036	0.029	0.061	0.045	Sofa1
0.021	0.016	0.037	0.045	0.021	0.038	0.04	0.079	0.039	Sofa2
0.029	0.015	0.047	0.035	0.02	0.035	0.039	0.077	0.045	Sofa3

Third step: positive ideal alternative and negative ideal alternative are defined as below and calculated with formula (6) and (7). (J' Is the cost criterion and J is the profit criterion).

$$A^+ = \left\{ (\max v_{ij} \perp j \in J), (\min v_{ij} \perp j \in J') \perp i = 1, \dots, m \right\} \quad (6)$$

$$A^- = \left\{ (\min v_{ij} \perp j \in J), (\max v_{ij} \perp j \in J') \perp i = 1, \dots, m \right\} \quad (7)$$

$$A^+ = 0.045, 0.079, 0.04, 0.038, 0.021, 0.047, 0.047, 0.016, 0.029$$

$$A^- = 0.039, 0.061, 0.029, 0.035, 0.02, 0.035, 0.037, 0.013, 0.021$$

Fourth step: oghlidosi distance of each alternative was calculated in contrast to best positive ideal alternative and negative ideal alternative based on the formula (8) and (9).

$$s_i^+ = \sqrt{\sum_{j=1}^n (v_{ij} - v_{ij}^+)^2} \quad (8)$$

$$s_i^- = \sqrt{\sum_{j=1}^n (v_{ij} - v_{ij}^-)^2} \quad (9)$$

$$s_i^+ = 0.023, 0.015, 0.013$$

$$s_i^- = 0.017, 0.023, 0.024$$

Fifth step: immanency to the best ideal as the final mark was evaluated based on the formula (10) and results are shown in Table (9).

$$c_i = \frac{s_i^-}{s_i^- + s_i^+} \quad (10)$$

Table 9: Calculated priorities for different options.

Relative proximity	Description of options	Rank
0.43	Textile sofa with classic design	1
0.61	Leather Sofa with modern design	2
0.63	Combined L sofa	3

Alternative ranking was in descending order. So the scheme 3 (the L combination) was selected as the best scheme and scheme 2 and 1 respectively were desirable for the people.

Conclusion:

Study on the result of this research shown that there is a straight relationship between the physical characters of sofas and the emotional of the consumers. This indicates that the use of certain physical properties lead to a certain feeling in consumers. According to the tables of factor analysis has been pointed out, the words extracted by background studying to describe the emotional quality sofa was suitable, The Words fashion, modern, charming, aristocratic and gorgeous and energizing all show feel different, new and more superior than others that in the Lukman. Et all article about the design of clothes had been fully refer to this group of words [24]. As expected, the attributes that are involved in some way with human emotions and due to the taste of people are different, characteristics such lovely, relaxing, fantasy, fine art, etc. classified in one group, and the two factors that in article Nakada (1997) the subject of designing the operators chair of these words were presented [23]. The third and fourth groups of words are completely unused in an article, but taken from various articles that attempt to describe how people feel about their product form of design [26].

L sofa because it combines both the features of a classic sofa that somehow it has a good style and modern furniture that is comfortable and has calming, is known as a superior design. This kind of sofas can be used both for personal and serving the guests and has the positive evaluation from customers and somehow is multifunctional and by the dimensions it is suitable for the apartment that has not the necessary space for tow kind of sofas. Also adding some cushion in different size and forms to this scheme leads to make some soft and sporty feeling besides the modernity to the customer that evaluate the worth of scheme and today's generation will concern more about this scheme. Sporty leather sofa has the higher rank than the classic sofa, this arising from that the modern leather sofa has more efficient for home and offices use, because the dark color so evaluate the worth of the scheme and become dirty later than the others scheme, and also leather itself lose its quality and form later and looks more luxury.

Given the importance impression design and necessity of using organized methods at present, Kansei engineering is one of the effective ways of Materials emotional design was used in this study. In this regard, this study was done on the top three schemes. Since the third scheme most votes were allocated, were discussed features that surpasses the scheme was compared with other designs, Thus we can conclude that Kansei engineering methods can be a good way to establish a relationship between the user and the product features used in emotion. One of the other results of this research is that the words role in showing the emotions so that guide and coordinate between the scheme and the emotions.

At last the restriction of the research was mentioned, emotional words that were chosen was from different essays that may not coordinate this research about the sofas and be wrong in describing the customer emotion. In analytical factors there was some restriction such that: Semantic interpretation of subjective factors, The problem of determining questions and the number of factors and in some part of this research less factor were used, so it needs more factors for further research to get more comprehensive area. In order to the wide range of sofa market and has a different form of sofas the scheme that used in the research was limited, using different form of the sofas in the research may cause the uncertainty in the results. It should be considered that it should be caution to generalizing the results of the research, because it is limited to the portion of population and geographical area. In Nakada studies, Jindo and Hirasago, Dehlgard *et al*, Lanzotti and Tarantino, the tool like a slide show, showing real and built examples, putting the person in a virtual environment were used, because this tools are more closer to the real word they make better feeling in the persons in order to evaluate more precisely but in this research because of time, being expensive these instruments were not be used [7, 13, 15, 23].

TOPSIS ranking method also has its limitations and can be replaced by other methods or relation between furniture design and emotional factors (as the second stage of Kansei Engineering) of using other method such as the linear regression models, Neural Network, fuzzy logic method, genetic algorithm. At last this research make the better vision of the emotion and behavior of the customers for the manufacturers in the wood and sofa industry, so that they can design the scheme more clearly to the customers feeling and make a good feeling in the customer that brings theme more sells and more benefits in the market. The result of this research indicate that there is a relation between the emotional and technical characteristics, so in this regard manufacturers can make the customer feeling by changing the design of product. So the designers offered the role of words in the user's emotions expressed no surprise, since that would lead them and more coordination between the design and the needs of the user's emotional results.

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