Journal of Theoretical and Applied Information Technology
20th March 2013. Vol. 49 No.2

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

DEVELOPMENT OF THE CONSUMING INTENTION PRODUCT DESIGN MECHANISM

HUNG-TENG CHANG

Asstt Prof., Department of Information Management, Yu Da University, Miaoli County, 36143, Taiwan, ROC

E-mail: cht@ydu.edu.tw

ABSTRACT

In recent years, the rising of customers' awareness and spending power has led to the growth of the customized products. The traditional enterprise-led products are unable to meet the customers' needs. Nowadays, the enterprises have to put the emphasis on the customers' preferences and products must be made to satisfy the customers' various needs.

In this research, we develop a set of Fuzzy Intention Product Design System. The system is capable of breaking the restrictions of time and space. Through the Fuzzy Analytic Hierarchy Process (FAHP), the triangular fuzzy numbers are put into the Pairwise Comparison Matrix to prevent the fuzzy problems during the process of conducting criteria measurement and judgment. By means of FAHP, the AHP Exact Value will be substituted by the Interval Value. And the experts will make strategic decisions with humanity when evaluating problems and give a weight value to the measure factors.

The LCD screen support structure is connected with the Internet survey platform and FAHP to construct the Fuzzy Intention Product Design Mechanism in this study. The results shown in this paper are expected to be references to the related study and the product designing.

Keywords: *Fuzzy Analytic Hierarchy Process (FAHP), Product model, TV support*

1. INTRODUCTION

Plastic products in daily life are pervasive. As the plastic material has a light, acid, rust, waterproofing, insulation and other features, none other materials (metal, glass, paper, wood) can be replaced. Thus, with the booming electronics industry plastic materials are widely used in 3C product enclosure. However, too much load on plastic products would produce distortion.

How to use the least plastic material, the simplest arrangement, the plastic products with the best strength, is an important design consideration. These developments of technology are the urgent needs for plastic products design. This study is intended to support the weight of LCD TV as an example, the design expertise, Internet survey by consumer preferences and recommendations, and enable designers to better understand consumers' intentions.

2. LITERATURE REVIEW

The important research methods would be described below:

2.1 Choose The Type of Support

The appearance of today's LCD TV market other than colors and materials, the main difference is in support. Therefore, this study mainly supports the development to design, collect several common shapes in the market as the study parameter.

2.2 Define The Parameters of Support

After the initial assessment of the literature in this study identifies the shape that majority of consumers loved. Based on the selected shape and then to analyze the factors affecting the control of the load. Initially this study selected five different shapes for support which are square, rectangular, disc-type, trapezoidal and arch. The pillars would select circle, square and rectangular these three shapes. After this two parts were selected then

according to the overall appearance to do the simulation analysis [1,2].

2.3 Fuzzy AHP

The literature review analysis, fuzzy AHP (FAHP) often used in group decision-making geometric shape can be obtained accurately and objectively weights. This should be quite consistent with the study of consumer intention LCD TV support analysis requirements. FAHP determined by AHP and fuzzy theory would be reviewed as follows.

2.3.1. Analytic Hierarchy Process (AHP)

Analytic Hierarchy Process (AHP) is proposed by professor Saaty at Pennsylvania University of Pittsburgh in 1971. It is used in determine priorities, resource planning, distribution and investment portfolio, etc. [2] In 1980 proposed a more complete methodology which would make a complex problem to be systematically simplified [3]. Use of hierarchy levels of decomposition for the problem and through quantitative judgments to be a comprehensive assessment to provide decision-makers choose the appropriate programs to reduce the risk of wrong decisions[4,5].

2.3.2. Fuzzy theory

Fuzzy theory is proposed by Professor Zadeh at the University of California Berkeley, in 1965. It is a fuzzy concept to quantify the knowledge. It is mainly for incomplete information do not need complicated calculation process and can make the right judgments. All knowledge can be fuzzification and its ability to provide greater promotional, error tolerance, and more suitable for applications in the real world nonlinear systems [6].

All function values in the range can be used as membership functions [7]. Common membership functions are triangular, trapezoidal and Gaussian membership functions [8]. The main purpose of defuzzication is to get clear from the fuzzy set of values to facilitate the calculation, and the calculation process is called defuzzification. The commonly used defuzzification methods are:

(1) Center of gravity method

Center of gravity method strikes the object same location, that is to strike a fuzzy set of the "center value" to represent the entire collection. Assuming ownership of fuzzy set A belongs to function $\mu_{\tilde{A}}(x_i)$, x_i is the variable value, then the function graph of the center of gravity is

$$F(x_i) = \frac{\sum_i x_i * \mu_{\tilde{A}}(x_i)}{\sum_i \mu_{\tilde{A}}(x_i)} \quad (1)$$

(2) Center of area method

If x_i is a variable value, then the function graph of the center area position is

$$F(x_i) = \frac{\sum [\sum x_i * \mu_{\tilde{A}}(x_i)] * x_i}{\sum [\sum \mu_{\tilde{A}}(x_i)]} \quad (2)$$

2.3.3. Fuzzy AHP

AHP decision-making cannot overcome the disadvantages associated with ambiguity. Therefore Laarhoven and Pedrycz developed a fuzzy AHP (FAHP) [9,10]. Triangular fuzzy numbers would be directly substituted into the pair-wise comparison matrix to prevent the measure in the treatment guidelines, to determine the course of such problems arising from ambiguity. FAHP replace the traditional AHP with Interval Value of Exact Value, so that experts in the decision-making could be more accurate assessment of the problem. Based on Saaty's view, each level of the project should not exceed seven. Because when more than seven items, in the appraisal process is easy to produce inconsistent, this affects the weight and thus influence decision-making purposes.

3. METHODOLOGY

1. This study was selected for TV supporting design, the development of consumer intention of supporting design system. Parameters affecting the appearance of the plastic support are divided into two parts: Pillar shape and the shape of the base parameters. The base parameters include chamfering, length, width, height and angle and so on. Pillar parameters include length, width and radius [11].

2. In this study, preliminary planning to establish hierarchy, which affect the deformation of the elements to be broken down into several groups. Each group then divided into several corresponding sub-groups, so successive layer down and creates all of the hierarchy.

3. In this study, the development of the supporting design hierarchy diagram, divided into the base and pillar. The appearance of the selected support is generally commercially

Journal of Theoretical and Applied Information Technology
20th March 2013. Vol. 49 No.2

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

available by the data collection for the exterior. Then identify the selected load deformation affect the appearance of important factors, is set to the corresponding sub-groups as seen on Figure 1.

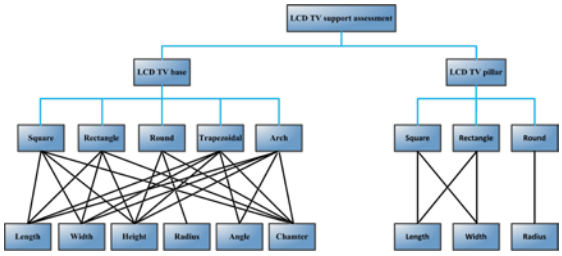

Figure 1: Hierarchy Diagram

3.1. Computing Weights Among All Levels

3.1.1. Establishing pair-wise comparison matrix

In the hierarchy built, this study intends to elements within the various levels of pair wise comparisons between elements. Above level elements is a class basis for assessing the importance of evaluation criteria. Therefore, if there are n elements then need to be n (n-1) / 2 compared in pairs. Comparing the results of the n elements placed on the pair-wise comparison matrix A part of the upper triangle. Lower triangular part of the value is the corresponding position on the value of the inverse triangle. Suppose that a_{ij} stands for the i element associated with the first j elements of the important weight ($a_{ji} = \frac{1}{a_{ij}}$).The main diagonal elements of each is self-comparison so the value of 1. This study evaluated by the group decision-making, so the calculation must be to integrate the preferences of individual decision-making. This section would use Saaty's proposal of "geometric mean" as a function of integration. If all pair-wise comparison matrices are consistent, its integration with the geometric mean of pair-wise comparison matrix would be consistent also.

3.1.2. Calculating the maximum eigenvalue and eigenvector

Pair-wise comparison matrix A tests whether the consistency requirements and must calculate the maximum eigenvalue λ_{max} and eigenvector w_i.

3.1.3. Consistency test

Assessment to determine whether decision-makers make the same decision must be done for each matrix consistency test. Calculate the Consistency Index (CI) and Consistency Ratio (CR) for each level.

$$C.I. = \frac{\lambda_{max} - m}{m - 1} \quad (3)$$

C.I. = 0 indicates completely determine consistency, also in line with mathematical Transitivity Law. Saaty proposed $C.I. \le 0.1$ for the allowable range of bias.

3.2. Calculate The Overall Level Weights

In this study, among the various levels of elements of the weight calculation, and then calculated the level of weights. If the consistencies test through the entire hierarchy then this level can apply. This study would use of Buckley (1985) proposed the average method to integrate the views of respondents, the integration formula is:

$$\tilde{m}_{ij}^{N} = (1/N) \otimes (\tilde{m}_{ij}^{1} \oplus \tilde{m}_{ij}^{2} \oplus \ldots \oplus \tilde{m}_{ij}^{N}) \quad (4)$$

3.2.1. Compute fuzzy weight

By the following calculation is calculated as fuzzy weight $\tilde{w}_i$:

$$\tilde{Z}_i = \left(\tilde{a}_{i1} \otimes \tilde{a}_{i2} \otimes \ldots \otimes \tilde{a}_{in}\right)^{\frac{1}{n}}, \forall i = 1,2,\ldots,n \quad (5)$$

$$\tilde{w}_i = \tilde{Z}_i \otimes \left(\tilde{Z}_1 \oplus \tilde{Z}_2 \oplus \ldots \tilde{Z}_n\right)^{-1} \quad (6)$$

3.2.2. Defuzzication

This study used Teng & Tzeng proposed the center of gravity defuzzification method [12], the solution fuzzy weight value DF_{ij} calculation process is:

$$DF_{ij} = \left[\left(R_{ij} - L_{ij}\right) + \left(M_{ij} - L_{ij}\right)\right] / 3 + L_{ij} \quad (7)$$

3.2.3. Normalization

Normalized weight value NW_i of the process is: $NW_i = DF_{ij} / \sum DF_{ij}$

3.2.4. Series of hierarchical

Through the above steps can be obtained at the final goal in the 0th layer of the NW_i weight for first layer of the i-th key factors, the first layer of the i-th key factors NW_{ij} weight for the layer 2 of the j-th dimension. To further obtain the ultimate goal of the layer 0 in layer 2 under the j-th evaluation index NW_k of the weight, it must be level series, the series as follows. And calculations by the above description, it can be level after the series of weights.

$$NW_J = NW_i \times NW_{ij} \quad (8)$$

3.3 Adding Fuzzy Concept of AHP

Traditional AHP method has a serious problem, that is, decision-makers subjective judgments of value or relative importance of the

imprecise value, as the exact values to deal with. For this reason, the results of the assessment and the practical problems often have gaps. In this study, the application of fuzzy theory to solve the comparability between the two factors of the problem. Hoping be more in line with the semantic description of human thinking. This part of the fuzzy numbers is used in the questionnaire design and processing.

This study collected Teng and Tzeng proposed rules focus on the formula ($NF = \frac{a + b + c}{3}$) to extract the fuzzy [12]. However, if all solutions of fuzzy data create by the formula the pair-wise comparison matrix would no longer have inverted value characteristics. Therefore, the use of a further modification of the formula NF ($NF = \frac{1}{(\frac{1}{a} + \frac{1}{b} + \frac{1}{c}) / 3}$), which can keep the value of the matrix with inverted value characteristic features.

4. SYSTEM RESULTS

System contains three major results: Hardware implementation, software development and enhance the user benefits results as shown in Fig. 2, and the details are described as follows:

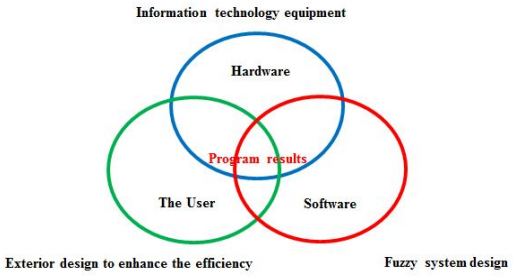

Figure 2: Schematic Diagram of Research Results

(1) Reduce costs and improve product quality and brand value

Combined with effective information technology for product shape design to reduce costs and improve product quality and brand value. Using the new system provides fast service to enhance the corporate image of 15% and 30% full-scale customers.

(2) Improve production technology and process management performance

Combined with effective information technology for product appearance design to reduce costs and improve product quality and brand value. This can effectively reduce the number of test and then accelerate the production schedule.

(3) System impressionable

Intention to design fuzzy systems by fuzzy AHP (FAHP), through the Consumer Intentions Survey results, as the LCD TV the appearance of the plastic bearing selection method. Provide product design and analysis of simulation technology while reducing development time. The experience of university-industry cooperation can be replicated in other industries and improve the competitiveness of enterprises [13].

(4) Low system maintenance cost

Intention to design fuzzy system itself is stable and reliable software system. The system has a very good extension. Through the system design prior to the relevant technical assessment to ensure that the system developed by the Institute with a very high degree of system stability and system maintenance costs are very low.

5. CONCLUSION

This study aimed to build a network of consumer intentions to market research product design system. This study combined with Internet market research platform to develop a "Fuzzy intention of the product design system." Internet market research could breakthrough by time and space constraints. Through Fuzzy AHP (referred FAHP) determine the course of such problems arising from ambiguity. FAHP based on interval-value to replace the exact values in traditional AHP. Experts in decision-making can make a more human scale of assessment to give a measure of the weight factor values.

Therefore, FAHP be effective in specific analysis of consumer intent on the fuzzy concept of product modeling. Combined with online market research platform and FAHP, offers the industry's product design reference.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

REFERENCES

[1] L.B. Louis, "Between thought and object in engineering design", *Design Studies*, Vol. 23, Issue 3, May 2002, pp. 219-231.

[2] T.L. Saaty, "Decision making with the analytic hierarchy process", *Int. J. Services Sciences*, Vol. 1, No. 1, 2008, pp. 83-98.

[3] A.S. AlGhamdi, "Management of combined ridge defect and osteotome sinus floor elevation with simultaneous implant placement--a 36-month follow-up case report", *J Oral Implantol* , Vol. 35, No. 5, 2009, pp. 225-231.

[4] P.A. Pilavachi, A.I. Chatzipanagi, A.I. Spyropoulou, "Evaluation of hydrogen production methods using the Analytic Hierarchy Process", *International Journal of Hydrogen Energy*, Vol. 34, Issue 13, 2009, pp.5294-5303.

[5] H. Min, "Evaluating the comparative service quality of supermarkets using the analytic hierarchy process", *Journal of Services Marketing*, Vol. 24 I Issue 4, 2010, pp.283-293.

[6] B. Jaouachi, M.B. Hassen, M. Sahnoun, F. Sakli, "Mechanical properties and appearance of wet-spliced cotton/elastane yarns", *Journal of Textile Institute*, Vol. 99, No. 2, 2008. pp 119-123.

[7] J. Deng, C. Hao, "The Smith-PID Control of Three-Tank-System Based on Fuzzy Theory", *Journal of Computers*, Vol. 6, issue 2011, pp. 514-523.

[8] H.J. Chu, L.C. Chang, "Application of the optimal control and fuzzy theory for dynamic groundwater remediation design", *Water Resources Management*, Vol. 23, No. 4, 2009, pp. 647-660.

[9] C. Du, S. Chen, X. Liang, "Application of Fuzzy Theory in Temperature Control System of Thermoforming Machine", *Procedia Engineering*, Volume 15, issue 2011, p. 639-643.

[10] F. Tiryaki, B. Ahlatcioglu, "Fuzzy portfolio selection using fuzzy analytic hierarchy process", *Information Sciences*, Vol. 179, 2009, pp. 53-69.

[11] H. Oktem, T. Erzurumlu, I. Uzman, "Application of Taguchi optimization technique in determining plastic injection molding process parameters for a thin-shell part", *Materials and Design*, Vol. 28, Issue. 4, 2007, pp. 1271-1278.

[12] G. H. Tzeng, J. Y. Teng, "Transportation Investment Project Selection with Fuzzy Multiobjectives", *Transportation Planning and Technology*, Vol.17, 1993, pp.91-112.

[13] B. Ozcelik, I. Sonat, "Warpage and structural analysis of thin shell plastic in the plastic injection molding" , *Materials and Design*, Vol. 30, Issue. 2, 2009, pp. 367-375.