

Print ISSN: 2234-3040 / Online ISSN: 2234-3059
doi: 10.13106/eajbm.2014.vol4.no3.27.

Using the MCDM of the Innovative Product Value Chain to Promote New Product Design

Shih-Chung Liao*

Received: April 07, 2014. Revised: June 18, 2014. Accepted: July 16, 2014.

Abstract

Purpose - In the past, designs for traditional products have usually focused on historic techniques. However, this tradition of using historic techniques has now been replaced by the trend of using the innovative design concept.

Research design, data, and methodology - To measure future market trends and quality requirements, we apply the results of the questionnaires and analyze them with various experimental processes and a design methodology. In this way, we gauge the impact of the innovative product value chain on the promotion of new products.

Results - Accompanied with an innovative product value chain, the product can stimulate the development of enterprise management, which has become the main issue in social and economic development in every developed country, and can facilitate the progress of enterprise management throughout the enterprise.

Conclusions - Customer demand should be emphasized as the primary means to solve design problems, to design optimal solutions, to create differentiation with competitors, and to pursue optimal marketing strategies.

Keywords: Multi Criteria Decision Making Theory (MCDM), Target decision system, Fuzzy theories, Gray system theories, Analytic network process (ANP).

JEL Classifications: G11, G33, M41.

1. Introduction

When facing this competitive era on product and globalization, it is key to create a design that will break the stereotype of traditional design process, and lead the team into innovation. The

enterprises now face many management dilemmas and must take the team to internationalization, which means the application of creative product design, and to produce the varieties, functions, appearance, user, market compartment, price diversity, etc. to satisfy the demand of consumers.

In the past, the key of successful product design relies on the accumulation of experience and comments of the users for years, and to cultivate the design ability of the product designers. Instance to, the models include two ways which are period parameters and the attribution on the future value. Basically, take the mode into practice to reveal the good fortune and convenience, which can precisely predict the technique development in the future, demand, and service time (Tseng & Tzeng, 2002). Whereas the method must change due to the trend, it is demand-oriented of customers. Researches on the improve usability is important, which including the style and management of the product, the sense and sensibility of designers, the trend of the product market, the modification of traditional management methods, the predicting on product fashion, the decision on creative product strategy, and the decision of the best policy, etc. Those are the methods which can produce the value of the products and to satisfy the convenience of customers.

Whereas multi criteria decision making (MCDM) analysis tend to focus on the arrangement and distribution of purposes, especially under the situation that few coherent strategies were made (Carlos, 2004). In order to help enterprises today deal with multi purposes in the market, the modification of organization in product strategy is needed. The product design not only requires the expansion on dimensions, but also the extent in different development levels. Pursuit of high highly productivity is a crucial step for an enterprise. Whether the enterprise can be sustainable operated depends on the transformation of innovation of product design plays an important role in this period. However, due to the limit on time and resources, the enterpriser cannot completely consider the problem of decisions making.

The research model on traditional product design process is, basically, based on an optimization mechanism of choice. In substance, the calculation is based on a sequence of calculating of establishment of product design. However, the strategy makers cannot understand the essence of the problem that whether the

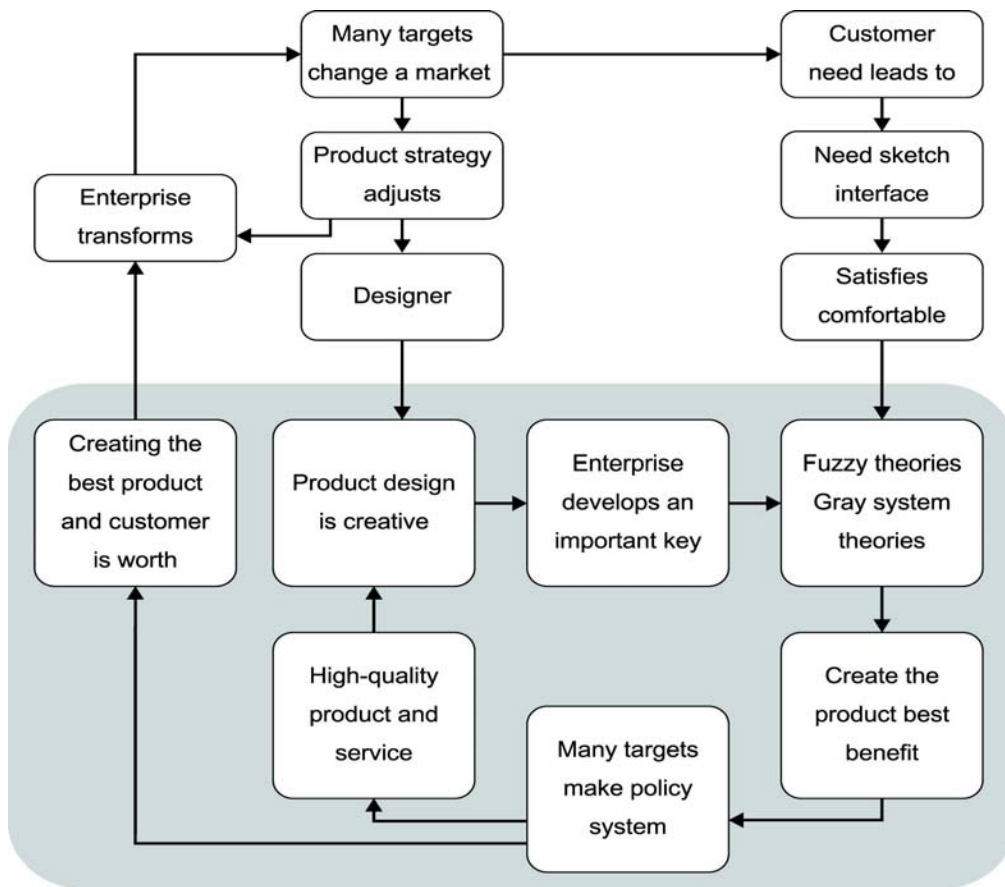
* Department of Visual Communication Design, College of Planning and Design Technology of Taoyuan Innovation Institute, Taoyuan, Taiwan 320. E-mail: liao1@tiit.edu.tw.

optimization could calculate the result of product design or not while facing a structural strategy problem. In the recent years, self learning and material exploring have become the point of studying effective tool. It focuses on the qualified course of strategy making, and the unpredictable environmental change instead of changing of time. Therefore, material exploring change the way of knowledge acquisition, which has become an important way in work (Hirota & Ye & Takeshi & Min, 2005).

In the past, with MCDM system, we can create the best qualified calculation in the complicity. This system decides the best strategy through the distribution under the principles of trust and interaction, and adapts the effect of reliance and feedback. Though ANP can solve problems generally and can obtain the

excess in the short time. The goal of analytic network process (ANP) is principle and interaction, exceeding the problem and feedback. ANP is the feature of AHP. And multi criteria strategy can solve the optimization in performance within using the limit of hierarchical structure and the applied purpose (Yu & Tzeng, 2006).

Next, set up a product decision making system under Analytical Hierarchy Process, Fuzzy set theory, Gray System Theory, Multi criteria decision making analysis in this article to produce the best quality and best service for consumers, and to establish the marketing predominance in the market and create the best benefit in product. Shown as Figure 1:



<Figure 1> Flow diagram of the Multi criteria decision making analysis system

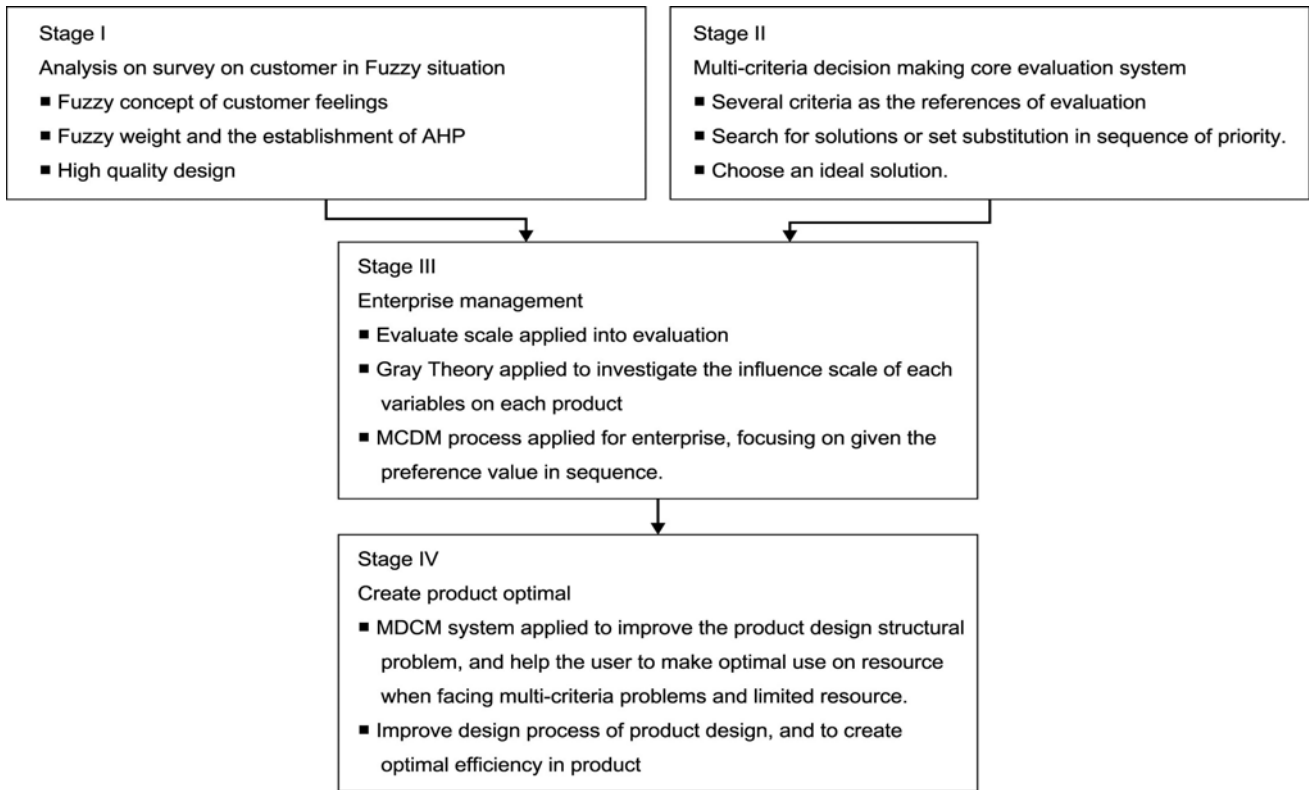
2. Proposed Method

2.1. Modeling the criteria for evaluating customer requirements

Since the customer requirements model of innovative product

design is a whole new challenge for enterprise, the difficulty and the risk of failure are much higher than those long period routine tasks. Learning the research method of creative product designing can be beneficial to controlling the design of new products and complete the goal successfully.

Divide the research methods into four stages in this article:



<Figure 2> Implementing phases of the create products optimal methodology

2.1.1. Fuzzy linguistic variable model approach

Adequate information and data is needed while the strategy makers face the problems in the procedure of product design. However, those data or information may contain multi-uncertainty or fuzzy situation; hence, the strategy makers have to adapt fuzzy theory and MCDM theory analysis, accompany with program and technique of designing plan to solve the problems in product designing. Therefore the enterprise can be recreated in the future.

The main point of research of fuzzy theory is that can possibly obtain intelligent brief system within access and set a matrix. By the result of the model we can apply the linear and non-linear recursive methods during the period. In fact, the problems can be solved with using the well-formed concept, knowledge, information, technique in designing. Those methods depend on the good knowledge model and expansion ability, which focus on limited but effective sustainable learning (Hu & Chen & Tzeng and Chiu, 2003).

The purpose of fuzzy theory is to help, strategy makers can realize the product quality of consumer demand, which includes the overall items like safety, usability, appearance, function, material, main faculty, etc., and also simplify the product. Plus, the designers can know the demand model of users with using various design techniques and methodology to complete the synthetic drilled by analyzing the appearance and color in nowa-

days in various products. Therefore the designers can solve the existing problems of the users; moreover, it can promote the design of product creation. Formula:

$$\delta = e^{-\frac{(X - a_1)^2}{b_1}}$$

Mainly roughly judge the demand of the product with leading the methods of product design and production, and then plan the purpose of demand on the first hand. Here is the execution:

1. Calculate the evaluation of demand and give weight according to importance.
 $A_i (i = 1, 2, 3... n)$
 $R_i = r_{i1} / v_1 + r_{i2} / v_2 + ... + r_{in} / v_n$
2. Calculate design demand evaluation, and then make fuzzy calculation of weight according to customer evaluation, hence to establish the demand and the fuzzy situation of design.

$$R = \begin{Bmatrix} r_{11} & r_{12} & r_{1n} \\ r_{21} & r_{22} & r_{2n} \\ \dots & \dots & \dots \\ r_{m1} & r_{m2} & r_{mn} \end{Bmatrix}$$

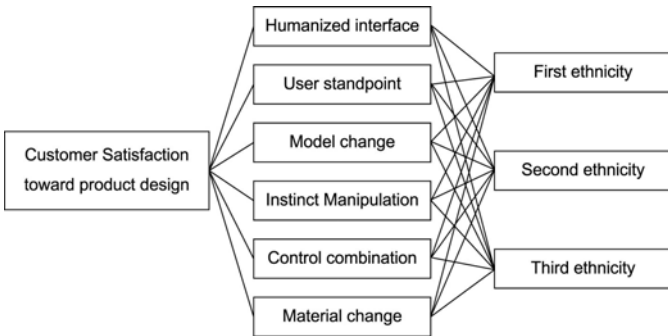
3. Give unification of the result value above.
 $V = \sum_{j=1}^n b_j v_j$
 $J = 1$

4. Calculate the weight and priority of the related factors.

$$V = \{vL / vL \rightarrow \max\}$$

2.1.2. Analytic Hierarchy Process approach

In order to deal with the highly competitive era of today's product, strategy makers can choose the best solution among the various choices by the reliability of AHP. This measure can not only be taken as a solution to the traditional product design, but also to modify the efficiency of the design itself. Therefore, strategy makers can get the division by dividing the available questionnaire replies according to their features.



<Figure 3> Evaluation of the complete hierarchy structure mapping mechanism

2.2. Evolutionary optimization of products design

In designing high quality products, the designer must know the required qualities of demand and take those elements in to consideration in the experimental samples; this includes quality, usability, material, battery, etc. The strategy makers can evaluate the calculation of product design.

In the beginning, researching and creating new product is in a fuzzy field. To make the find a better plan, the designer mainly focuses on the multi-purposes achievements. The establishment of multi-purpose can be suitable to the demand of customers and to improve product design to the best situation through several steps. First, we make regular standards and systemically turn it into the features according to demands. Then the features go to every part of functions and part of the product. Third, we make a process of production.

2.3. Standard and power of the product valuation are heavy

Evaluate the importance criteria of product designing in pair, shown as Table 1.

<Table 1> Establish six matrixes with heavy standard power

Six principles	weight
Humanized interface	0.25

Users standpoint	0.25
Mode change	0.1
Instinct manipulation	0.2
Control change	0.2

Realize that the results are identical under the SMART. It also shows that the satisfaction of Human-Computer Interaction (HCI) is the highest after the measurement, representing HCI is much more beneficial than others.

2.4 The decision system of more than targets is a basal reasoning mechanism

Use SMART to decide the preference of product. The first group emphasizes interactive benefit; the second emphasize quality; and the third emphasizes functions. Their preference for appearance is for quality, and for function. So set chart to show the preference of groups, shown as Table 2.

<Table 2> Preference of product consumers

Ethnicity user hobby	Ethnicity user values a type
First ethnicity	Person's machine interacts a benefit
Second ethnicity	Quality, material, additional
Third ethnicity	Main function, safety, comfortable moderation

2.5. The product designs of evolve the best quantity representation

MCDM involves determining the optimal alternative among multiple, conflicting, and interactive criteria. Many methods, which are based on multiple, attribute utility theory. The MCDM problems with dependence and feedback effects are hard for the decision maker to make a good decision. Although the ANP have been widely used to deal with this problem, some shortcomings should be overcome for proving the satisfaction solution.

The ANP was proposed in to overcome the problem of dependence and feedback among criteria or alternatives. The ANP is the general form of the AHP, which has been used for MCDM, to release the restriction of hierarchical structure, and has been applied to project selection, product planning, strategic decision, and optimal scheduling (Tzeng & Chiang & Li , 2006).

2.6. Evaluation on the optimization of product innovation operations

The trend of humanized facility changes the interface. In the past, keyboard and mouse are mostly required as the interface between human beings and computers. By the improvement of technological product, friendly HCI popularizes the innovative design application, and lead the prosperity in the technological industry. And humanized facility will be taken into consideration in the designing.

2.7. Development of new product

The application of innovative design can stimulate the product design to improvement. Therefore, how to efficiently apply the innovative interface, to explore new usages, to facilitate the users to use the interface intuitively has become the main-stream of design.

Ring	3
Style	9
Function	5
Color	6
Usability	5
Pixel	7
Battery life	3
Interact	9
Material	5

3. Case Studies 1

3.1. Telephone Designed

In this research, From 45 samples and 30 valid samples of questionnaires as research targets. Mainly focus on evaluating the preference of values among our users. Unlike traditional innovative design requires high quality and execute brand new design mission in a short time and in limited budget. So our goal is to create a feasible progress chart in the shortest time in dealing with problems we may face to.

While the problems happen in the process, use experiment result interface for the product design. In order to get the final question point and then by solve the problem in designing to achieve customer satisfaction.

3.3. Preference of product consumer's numbers

In this research, From 30 valid samples of questionnaires as research targets. gets100, 28 and 36 be worth for the user hobby, the appearance is a 100/100=1, the quality is a 28/100=0.28, function is 36/100=0.36. Make use of the layer class analysis method; choose effect valuation dimensions, as Table 4 shows as.

3.1.1. Modeling customer requirements

The customer requirements of the product include the price, ring, style, function, color, usability, pixel, battery life, interact, and material. Importance of the requirements is determined using MCDM.

<Table 4> Effects evaluate dimensions

	First ethnicity	Second ethnicity	Third ethnicity
First ethnicity	1	0.28	0.36
Second ethnicity	0.28	1	0.28
Third ethnicity	0.36	0.28	1

3.1.2. Product Innovative mechanism of Telephone Designed

Analyze the demand in telephone according to fuzzy situation. With the technological design, the product must be friendly designed in its HCI. It will be more popular in the analysis of screen. Innovative design telephone product can strongly accelerate the product designing to new trend.

Comprehensive above, the detection applies many attribute rating technique methods etc. to gain result is homology, through effect valuation dimensions analysis after, evaluate machine to interact benefit and satisfaction with the person are the most high, the representative values a person machine interaction a benefit than other of have a benefit more, by community decision the opinion have to pay a result.

3.2. Evolutionary experiment interface for the product design

After collecting the questionnaires, Quantify the product designing in the beginning of the experiment. Use hierarchical clustering to design a series of virtual creative products and service. Comparing with similar desire and demand, divide various customers into groups. Attends can realize the demand intensity and propose the overall product to make it convenient and practical to use. Moreover, can realize the demand of customers and achieve the required service.

3.4. Recognition on Telephone

Fuzzy Sets are adapted in the strategy of business administration. Take telephones for example. There are traditional, creative design, and simple styles to choose in the establishment of production, all of which point to the division in appearance, color, battery, function, usability, etc. Each of the categories is divided into five subcategories in the overall recognition, shown as Table 5.

With Hierarchical Clustering, can individually search the possible problems in designing process, and then plan the design criteria or setting to solve the problems, shown as Table 3.

<Table 3> Experiment result Design parameter for the product design

Problems	Design parameter
Price	4

<Table 5> Recognition on Telephone

Division	Traditional	Innovative	Simple
Output (per day)	215	180	140
Price (dollar)	6.5	4.8	4.1

Staff expense	52	35	22
Income in each phone (dollar)	90	125	115
Use degree	2	4	4

1. Index weight A: (according to Table 1)
(Humanized interface = 0.25, Users standpoint = 0.25, Mode change = 0.1, Instinct manipulation = 0.2, Control change = 0.2.)
 $A = (0.25, 0.25, 0.1, 0.2, 0.2)$ (1)
2. In this research, From 30 valid samples of questionnaires as research targets, shown as Table 6.

<Table 6> Division Three stypes

Division	Traditional	Innovative	Simple
R1	0.34	0.71	0.97
R2	0.72	0.54	0.12
R3	0.95	0.63	0.2
R4	0.69	0.81	0.37
R5	0.61	0.61	0.2

A misty to synthesize to judge formula
The index Single factor matrix R
 $B = A \circ R$ (3)

$$B = A \circ R = (0.25, 0.25, 0.1, 0.2, 0.2) \circ \begin{pmatrix} 0.34 & 0.71 & 0.97 \\ 0.72 & 0.54 & 0.12 \\ 0.95 & 0.63 & 0.20 \\ 0.69 & 0.81 & 0.37 \\ 0.61 & 0.61 & 0.20 \end{pmatrix}$$

$$= (0.41, 0.66, \text{ and } 0.61) \quad (4)$$

The result of the optimal quantification: $B = (0.41, 0.66, 0.61)$, which reveals that the innovative one is the maximum of 0.66.

Hence, according to the feature quantification, choose the second plan the innovative one as the optimal plan. It is optimal production. Consider the elements of cost, benefit, and usage, can choose the most appropriate plan. Therefore, in the actual design process, adapt the membership functions in fuzzy theory for searching the relevance between each feature, and get the best result in quantification.

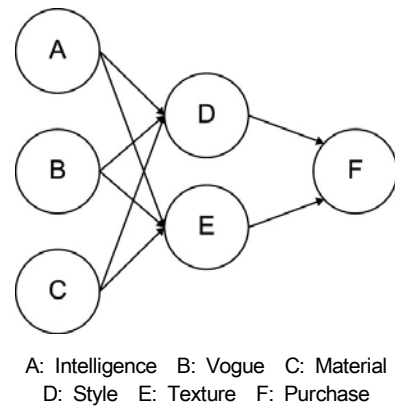
3.5. Development of Innovative Design Telephone

The innovative thinking of product design value chain focuses on the expansion of the maximum of service value. To provide the best service, realize the demand by the users standpoint of consumers, solutions, diversities, and benefit. And can find the correct solution to study the diversity of the service of the product. Take innovative designed telephone screen.

3.6. Establish the Inference Engine of Innovative Designed Telephone

The inference engine of innovative designed telephone takes

the design as the priority in the first step of product design. The success of the product selling in the market mainly depends on its design. Meanwhile, the design influences a lot in the quality and cost in development process as well. The aesthetic value is highly praised in the innovative designed phone. With the combination of wisdom, fashion, and various materials, the phone can definitely get out of the stereotype of traditional ones and create the classic. The phone can be made in high quality and humanized. To infer the innovative designed phone, list the rankings, shown as Figure 4.



<Figure 4> Product purchase rankings

3.7. Mechanism of Evolution in Innovative Designed Telephone

With MCDM theory, we mainly confirm the most appropriate solution of innovative designed telephone, which notice the difference between function, appearance, user, market segmentation, and price. Then adequately adapt the feature of groups of multi-criteria to plan the designing properly and to make it the strategy of marketing, hoping to improve the benefit.

In this research, four brands and 30 valid samples of questionnaires as research targets. Take the features of innovative designed telephone for the example for experimental outcome, which shows that the solution lies in the combination of feature design parameter and brand, shown as Table 7.

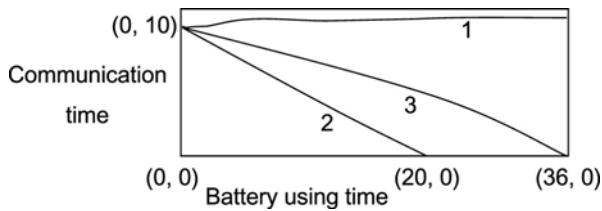
<Table 7> The experimental result of innovative brand designed telephone

Brand	Function	Appearance	Users	Market segmentation	Price
N	0.9	0.9	0.8	0.7	0.9
S	0.9	0.9	0.9	0.9	0.8
M	0.8	0.8	0.7	0.9	0.8
E	1.0	0.9	1.0	0.9	1.0

The combination of designed feature in innovative designed telephone (E) gets the optimal efficiency in product design. It contains complete internet and power-saving device and profound safety function, which are encryption, easy on-line, communication, web cam, video game, clock, GPS system, etc.

3.8. The Design of Interface of Innovative Designed telephone

The advantages of innovative designed telephone come from the control of interface design, reduction of production cost, and industry clustering. Those advantages are beneficial to the development of new consumed product. In Figure 5, first of all, horizontal line represents that the battery is full of electronic energy, and user hasn't make a call. Second, by the communication frequency grows, shows the curve of drop down in battery consumption. Three represents that under the consumption, the innovative designed telephone can extend its using time.



<Figure 5> Evolution of battery consumption in innovative designed telephone

MCDM is adapted for stimulating the proper solution to satisfy the consumers with various points of views. However, multi decision making theory would be widely adapted in the long term, uncertain environment. With this strategy, the decision maker can realize the optimal mode of the solutions to the problems.

3.9. Design of Innovative Designed Telephone

Due to the variety of telephones, the designer adapts the innovative design process to get the overall information through the standards and function. This then will be used to construct the function structure model, and to study the virtual construction to make it into practice.

Analysis on the elements of innovative designed telephones depends on the development of the industry. Expect the necessity of low cost, high flexibility in the superiority of production, the demand of humanized product is should be controlled since it will influence the concept of design and the development of crucial modules enormously.

<Table 8> Evaluation Result of Telephone Samples

Changeable variable in design										
Number	Price	Ring	Style	Function	Color	Usability	Pixel	Battery life	Interact	Material
1	0.8	0.3	0.8	0.8	0.4	0.4	0.7	0.6	0.8	0.4
2	0.9	0.4	0.7	0.7	0.5	0.4	0.4	0.6	0.7	0.4
3	0.8	0.3	0.7	0.7	0.3	0.5	0.5	0.7	0.7	0.5
4	0.9	0.3	0.7	0.9	0.5	0.5	0.7	0.5	0.9	0.6
5	0.7	0.4	0.6	0.6	0.4	0.4	0.6	0.8	0.8	0.4
Average	0.8	0.3	0.7	0.7	0.4	0.5	0.6	0.6	0.8	0.5

3.10. Consumer Awareness in the Innovative designed Telephone

With the change of use of consumers, the trend of design of innovative designed telephone changes as well. Hence, the newly touch technologies have shown up. We wish to improve the human-computer interaction benefit by the innovative screen. Therefore, how to explore the potential function demand of consumers, to provide innovative solutions, and to integrate the systems have become the challenges of designers.

Discuss the confirmation of demand items first by the method of evolution of innovative designed telephone. Mainly we are about to make the demand items of users, to collect the demand widely, to select the demand items, and to categorize the demand item, etc. Successfully create the design value of production through technological innovation and creation of competitive advantages in strategy. And then we observe the customer demands and propose the solution. Meanwhile, apply diversity analysis to provide optimized efficiency by initiation of product efficiency and value.

Why the evolution of innovative designed telephone becomes the highest amongst the satisfaction of consumers. Known that the priority is the appearance and the second is the convenience, function, standby time and the battery life, etc. Among the five indexes, appearance and standby time are specifically emphasized.

3.11. Supports for Innovative Designed Telephone System

The outstanding performance of innovative designed telephone in the competitive market is accomplished within the promising R&D and design according to the market and customer demands. Therefore, it is important to specifically realize the demand of customers according to their various demands, and to satisfy individual demands among all sorts of consumers. The plan tested individually on Price, Ring, Style, Function, Color, Usability, Pixel, Battery life, Interact, Material, each of them obtained points. The highest point is 1. The result reveals that Price and Interact are the most important among the index, shown as Table 8.

4. Case 2

4.1. Multi-Criteria Decision Making and Core Evaluation System

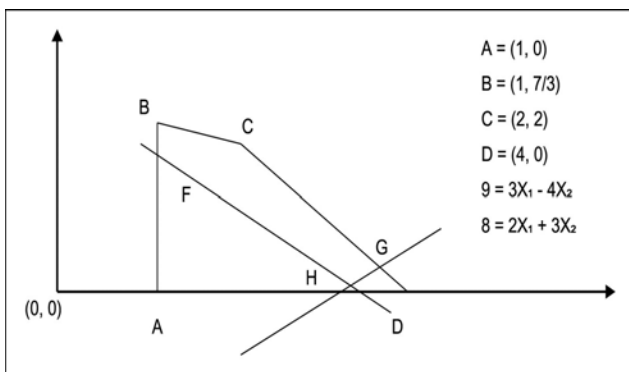
Take traditional and innovative designed telephone as the best choice, and apply MCDM and Core Evaluation system among the thirty questionnaires.

According to Table 5 Recognition on Telephone, show the above situation in the following linear programming model, Available Resource of Product Group.

- $8 = 2X_1 + 3X_2$ (The biggest profits target function 1)
- $9 = 3X_1 - 4X_2$ (The biggest profits target function 2)
- $X_1 + X_2 \leq 4$ (Labor time restriction type)
- $X_1 + 3X_2 \leq 8$ (Material restriction type)
- $X_1 \geq 1$ (Need restriction type)
- $X_1, X_2 \geq 0$ (not Take restriction type)

The solution of MCDM is called optimal vector, or vector optimization. Usually, it is a collection of a series of points, instead a single point. The oblique line is the available part to satisfy restrict in A, B, C, and D, which is the coordinate space (or decision space) of decision.

Find an available solution which is the ideal one according to the calculation in sequence of criteria. And can get a dimension of BCGHF above the satisfactory solution (59/17, 6/17), which is the range of user satisfaction, shown as Figure 6.



<Figure 6> Range of User Satisfaction

Therefore, the life period in telephone market shortens since the rapid transformation. In order to dealing with the situation, set a multi-criteria model in the beginning to control the demand. And here is the result of user satisfaction among 30users of sorts of types, shown in percentage, shown as Table 9.

<Table 9> Survey on the Percentage of Telephone Users Satisfaction

Type	Traditional type	Mini type	intelligent type
Use satisfaction	85%	90%	95%

Since there are different factors may influence the satisfaction

in different industries like tourism, food industry, general merchandise industry, retail business, and manufacturing industry, etc. Appropriate strategies are required in improving consumer satisfaction. So the designer must realize and analyze the features of product before making design drawing, including striking a balance between the relationship of cost and user satisfaction, which is highly emphasized in the research. In this journal, mainly focus on the discussion of customer satisfaction by Gray theory, Investigated the level of satisfaction among 30customers who bought the telephones for setting an analytical linear structure model, and to find the weights of various factors which influence the satisfactions.

Customer satisfaction of ages that purchase telephones is X_0 (According to Figure 4 Product purchase rankings)

1. Customer satisfaction of Intelligence is X_1
2. Customer satisfaction of Vogue is X_2
3. Customer satisfaction of Material is X_3
4. Customer satisfaction of Texture is X_4
5. Customer satisfaction of Style is X_5
6. Customer satisfaction of Purchase is X_6

In this research, From 30 valid samples of questionnaires as research targets. Mainly focus on evaluating the preference of values among our users, shown as Table 10.

<Table 10> Statistics of Survey on the Influence of Customer Satisfaction

Age	15~20	20~30	30~40	50 up
X_0	0.45	0.26	0.17	0.12
X_1	0.27	0.15	0.12	0.07
X_2	0	0.04	0.04	0.05
X_3	0.27	0.32	0.38	0.44
X_4	0.38	0.37	0.40	0.32
X_5	0.02	0.07	0.06	0.01
X_6	0.03	0.03	0.01	0

Apply percentage in the chart and directly calculate $\xi_i(k)$

- (1) First, calculate arithmetic sequence $\Delta(k)$

$$\begin{aligned} \Delta_1 &= (\Delta_1(1), \Delta_1(2), \Delta_1(3), \Delta_1(4)) \\ &= (0.18, 0.11, 0.05, 0.05) \\ \Delta_2 &= (\Delta_2(1), \Delta_2(2), \Delta_2(3), \Delta_2(4)) \\ &= (0.45, 0.22, 0.13, 0.07) \\ \Delta_3 &= (\Delta_3(1), \Delta_3(2), \Delta_3(3), \Delta_3(4)) \\ &= (0.18, 0.06, 0.21, 0.32) \\ \Delta_4 &= (\Delta_4(1), \Delta_4(2), \Delta_4(3), \Delta_4(4)) \\ &= (0.07, 0.11, 0.23, 0.2) \\ \Delta_5 &= (\Delta_5(1), \Delta_5(2), \Delta_5(3), \Delta_5(4)) \\ &= (0.43, 0.19, 0.11, 0.11) \\ \Delta_6 &= (\Delta_6(1), \Delta_6(2), \Delta_6(3), \Delta_6(4)) \\ &= (0.42, 0.23, 0.16, 0.12) \end{aligned}$$

- (2) Calculate the maximum and minimum of two sequences
 $\min_{i \in I} \min_k |X_0(k) - X_i(k)| = 0.05$
 $\max_{i \in I} \max_k |X_0(k) - X_i(k)| = 0.45$

(3) Calculate relational coefficient $\xi_i(k)$

$$\xi_i(k) = \frac{\min_{i \in I} \min_k |X1(k) - Xi(k)| + \max_{i \in I} \max_k |X1(k) - Xi(k)|}{|\min_{i \in I} \min_k |X1(k) - Xi(k)| + \xi \max_{i \in I} \max_k |X1(k) - Xi(k)|}$$

Apply $\xi = 0.5$, and get $\xi(k) = 0.275 / (\Delta_i(k) + 0.225)$

Substitute $\Delta_i(k)$ into the formula, and get

$$\xi_1 = (\xi_1(1), \xi_1(2), \xi_1(3), \xi_1(4)) = (0.68, 0.82, 1, 1)$$

$$\xi_2 = (\xi_2(1), \xi_2(2), \xi_2(3), \xi_2(4)) = (0.41, 0.56, 0.77, 0.93)$$

$$\xi_3 = (\xi_3(1), \xi_3(2), \xi_3(3), \xi_3(4)) = (0.68, 0.96, 0.63, 0.5)$$

$$\xi_4 = (\xi_4(1), \xi_4(2), \xi_4(3), \xi_4(4)) = (0.93, 0.82, 0.6, 0.52)$$

$$\xi_5 = (\xi_5(1), \xi_5(2), \xi_5(3), \xi_5(4)) = (0.42, 0.66, 0.82, 0.82)$$

$$\xi_6 = (\xi_6(1), \xi_6(2), \xi_6(3), \xi_6(4)) = (0.43, 0.6, 0.71, 0.8)$$

(4) Calculate gray relational grade r_i

$$r_1 = (0.68, 0.82, 1, 1)/4 = 0.875$$

$$r_2 = (0.41, 0.56, 0.77, 0.93)/4 = 0.668$$

$$r_3 = (0.68, 0.96, 0.63, 0.5)/4 = 0.693$$

$$r_4 = (0.93, 0.82, 0.6, 0.52)/4 = 0.718$$

$$r_5 = (0.42, 0.66, 0.82, 0.82)/4 = 0.68$$

$$r_6 = (0.43, 0.6, 0.71, 0.8)/4 = 0.635$$

Calculate relative degree, and get

$$r(X_0, X_1) = 0.875 \quad r(X_0, X_2) = 0.668$$

$$r(X_0, X_3) = 0.693 \quad r(X_0, X_4) = 0.718$$

$$r(X_0, X_5) = 0.68 \quad r(X_0, X_6) = 0.635$$

Relational Sequence

$$.: 0.875 > 0.718 > 0.693 > 0.68 > 0.668 > 0.635$$

$$r_1 > r_4 > r_3 > r_5 > r_2 > r_6$$

With the application of Gray system theory, choice r_1 is the maximum in influence, which can accomplish demand and create product value. With analyzing the main factors, found that Intelligence and Style are the most important factor, and then are Vogue, Materia, Texture, and Purchase, etc.

4.2. Establish Product Design Model Drawing

While set an object in designing a model, to make sure what kind of style pleases customer most. It plays the most important role in design. Then combine with the style and composition to make innovative creation and to reshape the overall design fashion. For example, we manipulate the various changes of product in 3-dimensions to show the beautiful style, and then produce the model drawing which is suitable to customer demands in the end.

4.3. Enterprise Management Decision

According to the telephone industry market and the coming enterprise management trend, can realize the competition which innovative telephone will face in the future. Those are product design position and market strategy, product management, creation of R&D value, design of organization structure of R&D, performance management and development mechanism. So the decision maker must set the industry goal and strategy to market competition.

4.3.1. Analyze Innovative Designed Telephone Market

To analyze innovative designed telephone, the product market can be divided into value chain(A1), wise financial management(A2), design and research&development(A4); for product management are product(B1), service(B2), marketing(B3); and for R&D structure are technique(C1), service quality(C2), management model(C3), and market environment(C4), etc.

In Chart 16, Range telephone enterprise management into 5 ranks, which are not important for 1 point, normal for 2 point, important for 3 point, and very important for 4 point. And the result reveals that "important" and "very important" are optimal in innovative designed telephone. And product (B1) and customized service (A3) get highest grades in the sum up. The result can be applied to realize the category of enterprise management, shown as Table 11.

<Table 11> Management of Innovative Designed telephone

Enterprise Management												
	Analyze market				Product management			Research&Development				
Item	A1	A2	A3	A4	B1	B2	B3	C1	C2	C3	C4	Total
Not important	4	0	0	0	0	4	4	4	0	4	0	20
Normal	18	6	9	6	54	0	9	18	45	9	12	340
Important	48	76	80	88	72	80	76	76	60	76	96	2268
Very important	25	45	35	30	50	40	30	15	50	30	15	1460
Sum	284	420	480	396	524	404	370	242	410	370	372	4088
Average	71	105	120	99	131	101	92.5	60.5	102.5	92.5	93	1068

4.3.2. Analyze the Evaluation Items of Product

For the evaluation items of product requires the intently combination of design technique and users, complete understanding of industry dynamic, application of technology, value-added man-

agement to users, integration of the interior and exterior resource, establishment of organization construction. Therefore, it is necessary to create optimal product and customer value during enterprise transformation, shown as Table 12.

<Table 12> Evaluation item and product value of innovative designed telephone

Item	Style	Marketing	Income	Preference	Financial	Brand	Strategy	Function
Marketing	very important	very important	important	very important	normal	normal	important	very important
Innovative	very important	normal	important	very important	important	normal	important	very important
Value	normal	very important	important	very important	important	important	very important	very important
Variety	not important	important	important	very important	important	important	very important	very important

4.4. Expecting Result of Research on Innovative Product Design

- 1) Product Innovation: New functions applied to innovative designed telephone will achieve the goal of innovation and provide appropriate product and service during the transformation. And it can help the enterprise to get rid of traditional cost and management dilemma.
- 2) Product Legitimacy: Let customs understand how an effective plan, relating to the product, has Reasonable and control in costs. Moreover, how it helps the designer work in designs, models, and analyzes, then by best resolving problems.
- 3) Product Aesthetic Value: Style, color, content, and service quality are very important in the overall appearance. Hence, improving aesthetics view of customer is efficient to promoting competitiveness of enterprise, which has been an ultimate goal of every enterprise.
- 4) Product Performance: With relative performance, market performance, and the performance among consumers, the enterprise has to establish the efficient and competitive strategy. The enterprise can understand the change in global market everywhere anytime through the performance of global customer satisfaction index, and to catch up with international in service level, to promote satisfaction and reinforce the competitiveness.

phone is in fuzzy field in the beginning. MCDM system is mainly applied in making strategy to make product design and in setting the product standard. First, systematically transform customer demand into product feature, and then expand to every part, and to plan the production process, controlling the manage points in each stage. Hence the designer can be suitable to customer demand and can be promoted with the optimal product design.

6. Conclusion

In the development of innovative designed telephone, we adapt the quantification solution like fuzzy theory, Analytical Hierarchical Process, MCDM theory, and product competition.

In the design process of innovative designed telephone, some problems wait to be solved. And must create innovative value, and get out of the dilemma, and to promote the strategy of new development of enterprise. With the promising thinking of wise financial management and customized management, we can promote ourselves by the creative ability through the process in the market, programming, marketing, explore, and design, and to make value chain become the most valuable factor in the design.

Hence, in the competition, Apply fashion aesthetics as technological innovation, and successfully achieve the goal of the delicate and creative design. So, the journal studies and establishes the trend in product innovative design, observes customer demand, controls the innovation, and stimulates the design ability. Last, we achieve the goal of user satisfaction toward the product.

5. Discussion

First, through deep analysis, understand the crucial customer demand of innovative telephone. Then with the relative analysis of combination of exterior demand and interior quality production, can control the key and imply the variables and to improve the quality to these crucial points, like web phone, which has been highly emphasized in its vocal quality and delicate simple style. Second, the research of innovative design tele-

References

- Tseng, F. M., & Tzeng, G.H. (2002). A fuzzy seasonal ARIMA model for forecasting. *Fuzzy Sets and Systems*, 126(3), 367-376.
- Carlos, R. (2004). A general structure of achievement function for a goal programming model. *European Journal of Research*, 153(2004), 675-686.
- Hirota, N., Ye, B. Y., & Takeshi, A., Min, Y. (2005). MOP/GP models for machine learning. *European Journal of Operational Research*, 166, 756-768.
- Yu, R., & Tzeng, G. H. (2006). A soft computing method for multi-criteria decision making with dependence and feedback. *Applied Mathematics and Computation*, 180, 63-75.
- Hu, Y.C., Chen, R.S., Tzeng, G.H., and Chiu, Y.J. (2003). Acquisition of Compound Skills and Learning Costs for Expanding Competence Sets. *Management Review*, 1(2), 257-273.
- Tzeng, G.H., & Chiang, C.H., & Li, C.W. (2006). Evaluating intertwined effects in e-learning programs: A novel hybrid MCDM model based on factor analysis and dematel. *European Journal of Operational Research*, 173 (3), 1026-1046
- Peter, I. S., Hongwei, H., Brian, W. D., & Douglas, E. A. (2003). Control and perception of balance at elevated and sloped surfaces. *Zootaxa*, 365, 1-20.
- Marc, J.R., & Lao, W.N. (2001). *E-Learning- Strategies for Delivering Knowledge in the Digital Age*. Taiwan: McGraw-Hill Int, Enterprises Inc.
- Wan, A.C., Tung, C. H. (2010). The impact of human resource capabilities on internal customer satisfaction and organisational effectiveness. *Total Quality Management & Business Excellence*, 6(21), 633-648.
- Wang, C.H., Chin, Y.C., Tzeng, G.H. (2010). Mining the R&D innovation performance processes for high-tech firms based on rough set theory, *Technovation*, 30(7), 447-458.