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The New Product Online Evaluation by Expert Based on the Analytic Hierarchy Process Method

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Abstract

This study analyzed an evaluation method on new product design over the internet. The expert evaluation is an essential part in product producing and consuming chain. The research takes the Tai Huoniao website (http://www.taihuoniao.com) as a thinking point, which used scoring on product design works. The research uses the analysis hierarchy process method in product evaluation, adding a quantitative analysis on expert-rating. The method also brings an influence on product design works in evaluating online. It is evident that the weight of criterion over the expert evaluation is strongly influenced consumer's decision-making. By the way of imposing weight on criterion after expert evaluation, it provides an approach for designer to learn more about how can a new product be assessed on computer screen. The weighting on criterion supports the new product design efficiently. The aim of the research is to evaluate the product design criterion in AHP method so as to meet the consumers' need.

Keywords: product design works on computer screen, weighting on criterion, analytic hierarchy process

1. Introduction

Shopping has been enriched by the surging of internet. Meanwhile, more and more people begin to purchase clothes and products online, instead of buy from stores and shops. In June 2014, there were almost 632 million people surfing on internet, data came from China Internet Network Information Center 2014. Compared to buy goods in realistic shops, internet is convenient to most of the consumers, without spacial limitation. It also offers a new virtual platform on brand value improvement.

The company provides various of internet services for consumers, even regarding the Internet as a new revival tool (Gupta, S., & Gupta S., 2014). The brand is defined as a network brand, which is the extension of actual brand (Thaichon, Quach, & Lobo, 2013). On the internet platform, brands offer products and services to consumers effectively (Dewan, Jing, & Seidmann, 2015). Therefore, on the background of modern scientific and technological network, as a new tool for traditional company, the internet primarily supports product promoting and propagandizing, offering more detailed information about product online.

We study the product evaluation online based on expert rating, mainly for three reasons. First, the key factors is the quality improve process (Lascelles & Dale, 1990). But when consumers get the products from internet, not all of them are satisfied. Researchers study online shopping in consumer intention (Chiang & Dholakia, 2003) consumer emotion and satisfaction (Westbrook & Oliver, 1991), collaboration online (Ta, Esper, & Hofer, 2015), and so on. We study on the expert rating that would support for product design works shown online, which is an important part in decision making on whether the product would produced or not. The rating result will affect consumer's decision directly.

Second, a part of website set up expert rating for new product design, and crowd-funding held online too. Taking Tai Huoniao as an example, it begins to share information about new new product design to designers, consumer and company on internet service platform. Consumer scoring is a part of product design works evaluation and crowd-funding. It also shows some data on how to improve the new design works indirectly. Designers can get the expert and consumer's feedback on the data platform.

The experts join in the producing and servicing process, and they take an important part in deciding the product

whether producing or not. The weight on product evaluation imposes an effective factor on producing process. The internet platform offers a chance for consumer to choose the product that they like. Without professional education on design, it is hard for consumer to forecast the potential problems while producing. The company will produce the design works which own high scores, evaluating by consumer and expert.Consumer that taking part in crowd-funding will earn rebate feedback since the products are sold.

2. Literature Review

2.1 Product Evaluation Methods

Internet became a main tool for product design innovation (Wind & Mahajan, 2002). It brought a new economy to brand, especially online shopping and product evaluation appeared (Reddy & Raju, 2016). Customers were involved in product design and evaluation process with the support of internet techniques (Dahan & Hauser, 2002). Product designers presented their works online and got more ideas from others after interaction (Kozinets, 1999). The fact showed that the emergence of the Internet has already brought a great number of factors to the brand strategy, strengthening the market competition (Simmons, 2007). Compared to the traditional sales model, the information is passed by internet to be more effectively. Meanwhile, even the market has been operated more efficiently than before, it still offered an opportunity for designer to evaluating product satisfaction. Consumers could check the detailed information of the product on internet (Ward & Lee, 2000). Therefore, in order to satisfy consumer's demanding, a number of product evaluation emerged online.

Collaboration with variable participants was a way to strength the brand competitiveness (Gulati, Norhia, & Zahere, 2000; Iansiti & Levien, 2004). The third parties composed by expert, who did not have profit relationship with company and consumers, were able to achieve the evaluation on product without bias (Sawhney, Verona, & Prandelli, 2005). The product evaluation imposed weight on criterion. It leaded to scoring more suitable. The score from expert decided on which product owned more opportunity to produce. The expert rating product owns its biases (Ashby, Walasek, & Glockner, 2015). For products evaluation, the previous rating affected the latter one's choosing behavior (Moe & Trusov, 2011). The paper supposed to put weight on criterion layer, adopting the weight scoring. Due to the differences physical characters in product design works, the weight on the product design works supported by the expert-scoring.

Crowd-funding was a communicating relationship which based on the crowd, gathering fund to support the collective action, which was sponsored by related organization and person (Ordanini, Lucia, Pizzetti, & Parasuraman, 2011). Through the internet platform, brand and designers both induced the demanding of funding and managed the project. Therefore, the crowd-funding helped the product to be formed efficiently and met consumers easily. Before crowd-funding, consumers and expert evaluated product design works from different view, that could be supported by the weight on product evaluation criterion.

2.2 New Product Evaluation Methods (NPEM)

There are many methods on new product evaluations.One of the stage is concept testing of expert opinions, which based on the opinion of different experts who have insights for product design and positions, including the predicting for the product consuming process (Ozer, 1999). Actually, experts have different opinions on new product. Analysis hierarchy process is also support the knowledge management (Ngai & Chan, 2005). Analysis hierarchy process is a method for product evaluation, which was proved by researchers. Researchers use the analysis hierarchy process method on product evaluation research through the screening decision (Calantone, Benedetto, & Schmidt, 1999). There are many papers used AHP method in different areas (Forman & Gass, 2001; Ho, 2008; Liberatore & Nydick, 2008; Ishizaka & Labib, 2009). The advantage of the evaluation method is used in product design.

3. Research Methodology: Analytic Hierarchy Process Model

3.1 Analytic Hierarchy Process (AHP)

The analytic hierarchy process (AHP) was set up by T. L. Saaty. In this study, the criterion weight was came from the AHP, which used in architecture and lead to effective decision-supporting (Saaty, 1982; Calantone et al., 1999). The AHP rated support the decision theory and measured elements by weights (Vargas, 1990). Actually, the evaluating criterion owned different weights.

Analytic hierarchy process was for qualitative and quantitative study, it used in many areas. AHP was a technique for multi-criterion decision making (Saaty, 1990). In the matrix equation, Thomas L. S.(1990) assumed the weights of w_1, ..., w_n are separately for A_1,..., A_n. The AHP method evaluated the evaluation on decision-making process. It included criterion and rating on decision-making, so as to impose the judge items with weight. The AHP was a linear relation of the criterion for product evaluation. The AHP was also the basis of

fuzzy analytic hierarchy process, it dealt with the variables of ambiguous linguistic (Cho & Lee, 2013). The paper used the AHP method on new product evaluation, mentioned in Thomas L. S. (1990). There were variable factors in product design, they lead product design to a comprehensive problems solving process. The design evaluation put weight on criterion, was superior to simple equal scoring. The decision on design works produced or not, the result would be more qualified.

3.2 Implementation Procedure of AHP

Saaty studied the AHP method in 1980. There was six steps can be concluded from the former studies (Saaty, 1980). The six steps explained the methodology of AHP (Bhushan & Rai, 2004).

Step 1 The AHP was composed by three layer, including goal and criterion. The three layers were composed the evaluation system. It stated the relationship among each level and each criterion. The result of weight would indicate the ranking of criterion. Even it was a part application of the AHP.

$$A = (a_{hk}), h, k = 1,2,3,..., n. \tag{1}$$

Step 2 Experts gave scores on each criterion data were collected for support the AHP goal. The product design works were rated by extremely good, very good, good, equal, bad, very bad, and extremely bad. The score could be collected as Table 1.

Table 1. Format for evaluating criterion scores

Number	1	2	3	4	5	6	7	8	9
Score on product	Extremely bad	Very good	Little good	Good	Equal	Bad	Little bad	Very bad	Extremely good

Step 3 The score on criterion were used in a square matrix for pair comparison. The (n, k) factor in the matrix was the reciprocal of (k, n) factor. The matrix had the form as follows. If the result of *n*th row was much better than *k* th column, the value of (n, k) was more than 1; however, the (n, k) element stood for the (n, k) element of the matrix.

$$A = \begin{bmatrix} 1 & k_{12} & \cdots & k_{1n} \\ 1/k_1 & 1 & \cdots & k_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ 1/k_{1n} & 1/k_{2n} & \cdots & 1 \end{bmatrix} \tag{2}$$

Step 4 The matrix gave the relationship on various criterion. The weights could be calculated by the ratings.

Step 5 The CI was used as consistency index.

$$CI = (\lambda_{\max} - n)/(n-1) \tag{3}$$

$$CR = CI / RI \tag{4}$$

Step 6 Rating each criterion by the weight.

Table 2. Random index of analytic hierarchy process (AHP)

order	1	2	3	4	5	6	7	8	9	10	11	12	13
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56

The AHP put weights on each criterion. The result represented which criterion was more important than the others, including the weight on each evaluation criterion. When consumer gives rating on product design work criterion, the final result will be more useful.

3.3 New Product Design Evaluating Criterion

There are many researches on new product development evaluation. The new product design was evaluated by different criterion. Analytic hierarchy process is a stage for inform designers make a good decision (Turan & Omar, 2014). It is used in the first stage of evaluation and analysis of conceptual product design (Ayag, 2005). The ranking from expert and consumer on design evaluation has been more efficient for design. Production cost relates to economical criterion. Aesthetic impression is the result of product perception, which implies consumer

preferences (Chou, 2011). The new product can be improved on computer screen, where the information and details are exhibited; AHP is a decision making model (Calantone et al., 1999). Durability, quality of the materials and assembles are related to the product evaluation. The weights are based on the intention, and the parameters of the product are based on the product characteristic (Remery, Mascle, & Agard, 2012). On the design characters of the product, the evaluating criterion is set up.

4. Case Study

4.1 Development of New Product Evaluating Model

4.1.1 The New Product Scoring Method Used Now

The expert scoring is a process among different evaluations on Tai Huoniao. The new product which got high score will be produced after crowd-funding. While, five experts merely post evaluation on all design works from four aspects, including design (40 percent), utility (30 percent), appearance (20 percent) and creative idea (10 percent). All of the product design works own the same weight and criterion. No weight on the product evaluation mentioned on the brand website.

4.1.2 The AHP Method on the New Product Scoring

Consumer influenced by the product scoring from experts, but expert and consumer were rating the same product in different ways, while the low-status person always influenced by the choice of the high-status ones (Jacobsen, 2015). The conceptual product inter-design works are from the workshop China-South Korea-Japan collaborated workshop in March 2016. The product was designed by a group of master students. The four steps concluded from the design method (Hsiao, 2002), as follows.

(1) Market investigation and product analysis

To design the eating tool for people, the kimchi plate design was studied in workshop, detail stated in following. First designer asked 10 consumers the same question, "what do you think is the five important criterion in plate design works evaluation?". The question also asked to 3 experts and 3 designers. After communicated with all participants, the conclusion was shown the five most important criterions.

(2) Design goal and criterion

The data from the expert evaluation were qualified by the analysis hierarchy process method. After asking 16 persons about their opinion on plate using experience in daily life, there was a five most focused point on how to design a kimchi plate. The criterion set up on multi-variable participant idea. The criterion included the innovation, aesthetic, economic, function, and security. More details were as follows,

- Easy handle.
- High quality and good material.
- Low price.
- Use safely and surface smoothly.
- Look good color and shape.
- Touch well.

(3) Idea developed in design works

The five design criterion were formed a goal in Table 3. All the criterion of evaluation for the goal of the new product evaluation was decided by the quantitative study on designers, experts and consumer.

Table 3. The new product evaluation method

Goal	Criterion
The new Product Comprehensive Evaluation：Plate Design	Innovation（B_1）
	Aesthetic（B_2）
	Economic（B_3）
	Function（B_4）
	Security（B_5）

(4) Product evaluating online

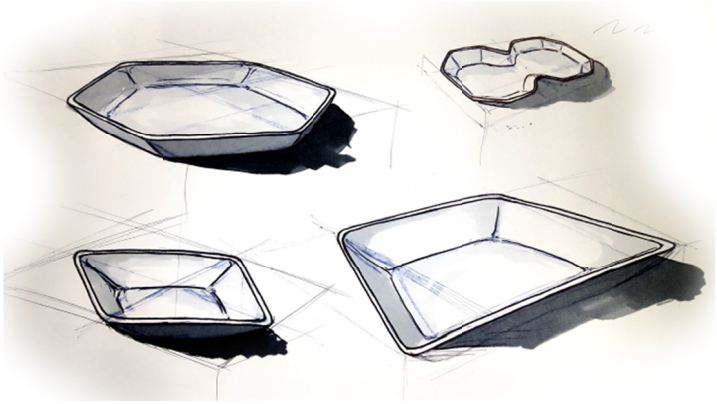

Figure 4. A drawing of kimchi plate

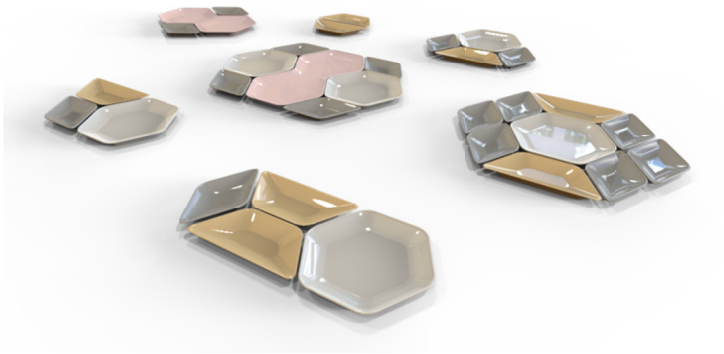

Figure 5. A design work of kimchi plate

Figure 6. A design work shown of kimchi plate

According to the analytic hierarchy process method, we set up the new product evaluation Method. The goal set on the product design evaluation, including the quantitative research among consumer, expert and designer. According to design elements evaluation, the main goal was to achieve weighting on product evaluation items. After design research, the criterion layers composed by innovation (B_1), aesthetic (B_2), economic (B_3), function (B_4) and security (B_5) as shown in Table 3. The sub-criterion were not denoted, the expert owned different

backgrounds, while evaluating the new product on computer screen on their personal views, it presented more standard and accurate decision (Ozer, 2005; Brown & Eisenhardt, 1995).

4.2 Analysis and Results

The results provided an evaluation for kimchi plate design works. In the study, we applied the AHP method to put weight on the criterion, which would improve the decision making more efficiently. Scores given were used for construct the weight in the matrix in Table 8. The matrix consisted of five categories: innovation, aesthetics, economic, function and security. Each one scored one point value among 1 to 9 in Table 7. The rating system was built on 9-point scale.

As the three experts own similar background, the each criterion scores was totally divided by three. So, the innovation score is 16/3, aesthetic is 22/3, economic is 19/3, function is 23/3, security is 22/3.

Table 7. The expert scoring on the plate evaluation

criterion	Expert No.	Evaluating criterion scores (1=extremely bad; 9=extremely good)									Details
		1	2	3	4	5	6	7	8	9	
	A			√							
Innovation（B_1）	B					√					
	C								√		
	A						√				
Aesthetic（B_2）	B									√	
	C							√			The given score by expertise shown by the signal of "√".
	A								√		
Economic（B_3）	B				√						
	C							√			A, B, C in table stands for the expertise order.
	A								√		
Function（B_4）	B								√		
	C							√			
	A							√			
Security（B_5）	B									√	
	C						√				

Table 8. Comparison matrix for criterion

criterion	Innovation	Aesthetic	Economic	Function	Security	Normalized Weight
Innovation	5.33/5.33=1	5.33/7.33=0.73	5.33/6.33=0.84	5.33/7.67=0.69	5.33/7.33=0.73	0.16
Aesthetic	7.33/5.33=1.38	7.33/7.33=1	7.33/6.33=1.16	7.33/7.67=0.96	7.33/7.33=1	0.22
Economic	6.33/5.33=1.19	6.33/7.33=0.86	6.33/6.33=1	6.33/7.67=0.83	6.33/7.33=0.86	0.19
Function	7.67/5.33=1.44	7.67/7.33=1.05	7.67/6.33=1.21	7.67/7.67=1	7.67/7.33=1.05	0.23
Security	7.33/5.33=1.38	7.33/7.33=1	7.33/6.33=1.16	7.33/7.67=0.96	7.33/7.33=1	0.22
λ_{max} =5.00, CI=0, CR=0<0.1						

In the evaluation model, the designer revised design products, according to the expert given weight and consumer can rate the product evaluation criterion in the following. The consumer scoring was not the key point in the study. After using the method of analytic hierarchy process, the result was valid as CR <0.01. Each criterion rated by the different weights.

The evaluation model was used for virtual product design assessing. The case study shown that the products got weights on criterion from experts, and it led to the scoring from consumer more useful. Table 8 used the application of the AHP matrix model, which shown the weight on criterion from expert rating. As shown in Table 8, the result of plate assessment with regard to the criterion is based on the data in Table 7. In this example, each criterion became a uni-factor. The final weights of the product design works were assigned by the AHP method. After the rating from the consumer, the product evaluation system would offer the final score after imposed the weight.

This example suggests that a product design evaluation model would be devised to the detailed layer. We expect that this evaluation model could be used to analyze the product design vital works and to bring more opportunity to improve product design before producing.

5. Discussions and Conclusions

5.1 Discussions of the Study

The study began from more than one year ago in a PhD student's course "Brand Innovative Introduction". The research mainly focused on brand product rating online. In this year, using the evaluating method on the product design works of China-Japan-Korea collaborated workshop, the final work was presented on computer screen, the same as presenting online.

In the product evaluating process, the expert considered problems before the product produced. For example, the plate was difficulty to handle or too heavy. The problem would be solved by designers. Furthermore, the criterion gave the expert a main direction on rating. After using the AHP method, each items had a denoted weight, rather than equal. Therefore, the AHP not only could be used in design work assessment, but also good for product usability.

Multiple of company used the product evaluation online. Consumer checked the score from others and weight for each criterion. However, the weight of expert improved the product quality, while, consumers usually shared with others about product using experience. In this situation, the AHP was required for weight on criterion. Though a plate was taken as an example in the research, this method could be used in many other product evaluations online too. It leaded to a more quality way on control high quality of products. Since the evaluation was given by expert and presented online, consumers would consider it before crowd-funding. The evaluating order was important. Expert took an important role on producing process because after expert rating, consumer could give a score on product design works and crowd-funding online. Once the designed product was produced, it will match the market need.

The development of internet technology applied a wider space for brand development and promotion. Over the internet, the brand provided much better products and services. At the same time, in order to reduce the storage and wastes, based on the consumer's demanding, product design and selling would be aimed. Under the weighting on expert evaluating method, not only could it provide information to the producer, but could also sent the useful data to designer who would design good product, it would lead the design trend to satisfy the consumer's pursuing.

5.2 Conclusions of the Study

The study made a contribution to the new product design works evaluation. From a theoretical view, this study made contribute in several ways. To improve the product in competitive market effectively, it is important for company to develop a high quality product and fit the consumer's need. In this study, the method AHP for evaluating a design work can draw the conclusions as follows. First, the AHP method can be used in new design works qualify evaluation. Each criterion imposed different weight in AHP method by experts, the results can be seen by consumers. The results will offer some help for consumer decision. The result offers an advice for consumer crowd-funding. Second, the criterion is decided by designer, expert and consumer, after quantity research process and conclusion. The parameters can be more qualified. With this method, the expert can give rating on product and shown online, the result is visible by consumer and designer too.

The study also transforms the expert scoring into product evaluation criterion, puts weight on design evaluating criterion before which product design works produced. Therefore, the results of the study have an important effect on online product design works evaluation. For example, the consumer might consider all criterion equally, as they do not own design education background, it is quite difficult for them to decide which factor is important.

5.3 Limitations and Future Research

There are few limitations in the study. First, the study researches on new product design evaluation, meanwhile,

analysis hierarchy process method is the main method. Therefore, the way to chooses three experts owns disadvantages. The expert number can be added in the following research. Second, our proposed a model focuses on the weight from the score of expert evaluation. The experts do not own any weight on their score for product design works. However, it is helpful to add weight on criterion before consumer scored. Future research can improve the model by increase the number of experts. Finally, the weight from expert maybe influenced by the expert characters, including age, education level, work experience and so on. In the future work, there are many various methods on product design evaluation methods, which can study on different factors, it is helpful on product design works whether produce or not.

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