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The Application of Value Analysis Based on Kano's Two Dimensions Model and Value Expansion Model

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Abstract: How to obtain the useful Business Intelligence (BI) had known as an important work for most enterprises in Taiwanese, especial for the leisure industry. Hence, in this study, we will demonstrate a value analysis procedure based on the Kano's two dimensions model and value expansion model to address such issue. Besides, an illustrative example owing to the leisure farming at Taitung area in Taiwan is also taken to demonstrate the feasibility and rationality of the proposed procedure. The important findings and conclusions in this study can be summarized as: (1) the Must-be values (keep health, self-satisfactory, leisure experience) for leisure farming case were mined by using the proposed Kano's model; (2) the important products/services, benefits were obtained from the Must-be values by using the proposed value expansion model; (3) managers can know how to rationally and feasibly construct their corresponding competitive strategies for different customers' clusters.

Key words: Value analysis, Kano's two dimensions model, leisure farming, customer clustering analysis, value expansion

INTRODUCTION

According to recent industry report, leisure farming has rapidly grown to become a significant industry in Taiwan. Many relating policies were proposed by Taiwanese governments to aid the promotion of the leisure industry (Tourism Bureau, 2007). As for those managers in leisure industry, the issues about resource reallocation, products/services development or marketing strategies enhancement will be made to improve their core competitiveness and to enhance their Business Intelligence (BI). After reviewing the characteristics of the Taiwanese Leisure market, it reveals that leisure farming operators passively supplied Products/Services (P/S) to consumers without considering consumer's considerations. In recent years, more customers have begun actively requesting products from the leisure industry and the industry has responded by satisfying customer requirements. Consequently, leisure industry operators must consider how to incorporate a customer orientation into their Business Intelligence (BI) activities. Business Intelligence (BI) is acquisition andutilization of fact based on knowledge to improve a business's strategic in the marketplace (Huber *et al*., 2001; Dresner, 2001). The BI is a broad topic, covering many different functions (e.g., reporting and analysis) and technologies, e.g., data warehouse, online analytical processing (OLAP), portal. Taking data be generated by the operations of an enterprise and translating data into relevant and useful information for consumption by people throughout the enterprise will be primary consideration for addressing BI issues (Liautaud and Hammond, 2001; Baxter, 2005).

The concept of value has been applied in various fields such as economics, social science, accounting, finance, strategy, product management, information system, marketing (Huber *et al*., 2001; Ulaga and Chacour, 2001). Holbrook (1999) defined customer value as an interactive relativistic preference experience. Patterson and Spreng (1997) pointed out that customer value in the marketing literature is generally defined from the consumer's perspective. Superior customer value has been associated with strong customer orientation (Gowan *et al*., 2001) and customer satisfaction (Eggert and Ulaga, 2002). Satisfied customers are more likely to repurchase the product/services (Baker and Crompton, 2000; Patterson and Spreng, 1997) andspread positive word of mouth (Petrick, 2002). Related theories and applications are stress the linkage of three connected layers, namely P/S attributes, benefits and values (Gutman, 1982; Holbrook, 1996, 1999) with the forward hierarchy. Hence, the concept of connected layers will be worthy to be included into the value analysis.

Kano *et al*. (1984) proposed a two dimensions quality model to resolve such problem in the issue of quality management. The concept of Kano's two dimensions model can be stated as the possible result of satisfactory evaluation may represent as satisfactory, no satisfactory

or no comments even though there are sufficient values. The Kano's model is widely accepted in current research, such as Huiskonen and Pirttila (1998), Pawita and Tan (2003) and Kuo (2004), besides, it was integrated with others quality management tools were proposed in many researches, such as, Matzler and Hinterhuber (1998) integrated Kano's model with QFD to product development more successful; Shahin (2004) integrated Kano's model with FMEA to make it customer oriented. It indicates that is beneficial in improving the quality management. Due to the quality satisfactory of customers can be judged via value evaluation, we will intend to apply the Kano's two dimensions quality model into analyzing the customer's values.

As we known, customer segmentation can be viewed as an effective way to perform the market analysis. In order to perform the detailed analysis, we also need to construct the corresponding values expansion for each customer clusters or segmentations. Herein, we will apply the Self-Organizing Feature Map Neural Network (SOMNN) which is owing to the unsupervised Artificial Neural Networks (ANNs) to perform the clustering analysis (Kohonen, 1982, 1990) due to the popular feature of self-learning and parallel computing (Hinton, 1989; NeuralWare, 1990). The values expansion model (i.e., the expansion from values to product/service attributes) can also be constructed based on the related importance consideration for multiple criteria (i.e., the multiple values) and the linkage relationship among those three connected layers.

Finally, an illustrative example owing to leisure farming at Taitung in Taiwanese service industry will be employed to represent the feasibility and rationality of the proposed procedure.

TECHNIQUE BACKGROUND: SELF-ORGANIZING FEATURE MAP NEURAL NETWORK (SOMNN)

The architecture form of the SOMNN network is based on the understanding that the representation of data features might assume the form of a self-organizing feature map that is geometrically organized as a grid or lattice. In the pure form, the SOMNN defines an elastic net of points (parameter, reference, or codebook vectors) that are fitted to the input data space to approximate its density function in an ordered way (Kohonen, 1982, 1990).

The components in SOMNN are the input layer and the topological map, a layer of nodes topologically structured. Two-dimensional array of output nodes was frequently used to form self-organizing map (Hinton, 1989). Every input node is connected to every output node via a variable connection weight. A layer of two-dimensional array of competitive output nodes is used to form the feature map. The lattice type of array can be defined to be square, rectangular, hexagonal, or even irregular. The most used forms are the square and the hexagonal arrays of nodes. This structure is not explicitly defined in the architecture of the network at the moment of its design. The interest of this network resides in the neighborhood structure that develops progressively by learning and arises from the nodes behavior. It is the self-organizing property. The SOMNN belongs to the category of the unsupervised competitive learning networks (Hinton, 1989; Kohonen, 1982, 1990). In the SOMNN, the competitive learning means also that a number of nodes is comparing the same input data with their internal parameters andthe node with the best match (or it can be said as winner) is then tuning itself to that input, in addition the best matching node activates its topographical neighbors in the network to take part in tuning to the same input. More a node is distant from the winning node the learning is weaker. It is also called unsupervised learning because no information concerning the correct clusters is provided to the network during its training. Like any unsupervised clustering method, the SOMNN can be used to find clusters in the input data and to identify an unknown data vector with one of the clusters. The detailed context of SOMNN can be referred to Kohonen (1982, 1990).

THE KANO'S TWO DIMENSIONS MODEL

Working with social science theories on satisfaction developed by Frederick Herzberg. Kano *et al.* (1984) concluded that the relationship between fulfillment of a need and the satisfaction or dissatisfaction experienced is not necessarily linear. They found that the requirements could be sorted into distinct classes and that each class would exhibit a different relationship with respect to satisfaction. According to this concept, a product induces various distinct types of satisfaction or dissatisfaction, depending on whether certain customer needs are completely fulfilled (Berger, 1993).

These requirements can cause reactions ranging from dissatisfaction, through indifference, to satisfaction, depending on how well they are fulfilled. There are five type categories defined as follows:

- **Attractive quality:** Attractive quality attributes can be described as surprise and delight attributes; they provide satisfaction when achieved fully, but do not cause dissatisfaction when not fulfilled

- **One-dimensional quality:** One-dimensional quality attributes result in satisfaction when fulfilled and dissatisfaction when not fulfilled
- **Must-be quality:** Must-be quality attributes are taken for granted when fulfilled but result in dissatisfaction when not fulfilled
- **Indifferent quality:** Indifferent quality refers to aspects that are neither good nor bad, and consequently, they do not result in either customer satisfaction or customer dissatisfaction.
- **Reverse quality:** Reverse quality refers to a high degree of achievement resulting in dissatisfaction and to the fact that not all customers are alike

THE PROPOSED VALUE ANALYSIS BASED ON KANO'S TWO DIMENSIONS MODEL AND VALUE EXPANSION MODEL

In order to realize the key values and mine the critical P/S attributes based on customer's recognition, we intend to incorporate several useful techniques to solve such issue. Two stages will be included in the proposed approach and they will be defined as follows.

Stage I: Perform Kano's two dimensions model to obtain the meaningful values

- **Step 1:** Key values for leisure farming can be explored via reviewing the related literatures or conducting detailed with experienced practitioners or managers. Possible candidate values that affect customer satisfaction can be then obtained
- **Step 2:** The questionnaire collects information regarding the evaluations about three parts: the first part deals with demographic characteristics (such as sex, age, incomes, place of residence, occupation and interests), the second part is the evaluation for those items to be sufficiently kept and third part is the evaluation for those items to be not sufficiently kept from the viewpoint of customers. An on-line questionnaire collection platform is constructed to collect customer data
- **Step 3:** Determine the category of value according to Table 1 (Schvaneveldt, Enkawa and Miyakawa (1991)) and compute the percentage of each category to all customers. Next, the actual category type with the maximum percentage value can be determined by screening out all values

where, 1, 2, 3, 4 and 5 will denote the positive Likert five Scale. Each question will have two parts to be answered by customers: What is the evaluation for the item being sufficiently kept? And what is the evaluation for the item not being sufficiently kept? The percentage value about A, O, M, I an R for all customers can be computed and the final category type for the particular item can be determined by choosing the category type with the maximum percentage value

- **Step 4:** Based on the category results for all items, the attractive values (A) are first selected for use in the later expansion analysis. If no attractive values (A) can be obtained, the Must-be (M) values can be selected for use in the subsequent value expansion analysis

Stage II: Perform the values expansion analysis

- **Step 1:** Due to the different customer entity, the clustering analysis (it is graphically depicted in Fig. 1) can be separately performed. And then, the customer value expansion model can be constructed according to each cluster. Herein, those attributes including social variables, the expectations evaluation of Products/Services (P/S), Benefits (B) and Values (V) of the regular customers will be viewed as the clustering variables. The popular SOMNN will be chosen as the clustering tool in this phase (NeuralWare, 1990). After performing the necessary clustering analysis, the possible customer segmentation will be obtained
- **Step 2:** The value expansion model for different customer cluster will be constructed. The core architecture of value expansion model can be manipulated by matrix computation. Three matrixes were initially constructed and they can be represented from Eq. 1-3. For each customer cluster, we can apply this method to obtaining their corresponding value expansion model. After each value expansion model being constructed, the practitioners can obtain the important items about P/S, B and V. As for the important items of P/S, B and V, the Top N (it can also decided by users) can be used to aid our analysis depending on the consideration of resources investment or constraint limitations

Table 1: The category table for Kano's two dimensions model

	Category				
Items	Attractive element (A)	One-dimensional element (O)	Must-be element (M)	No Interest-indifferent element (I)	Reverse element (R)
Be sufficiently kept	5	5	4, 3, 2	4, 3, 2	1
Be not sufficiently kept	4, 3, 2	1	1	4, 3, 2	5

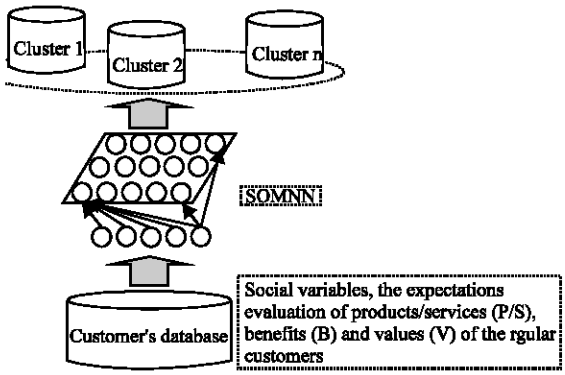

Fig. 1: The concept diagram of clustering analysis

$$\text{Important degree of Value (V)} = [\text{V-1,V-2,...,V-n}]_{1\times n} \quad (1)$$

$$\text{Important degree of Benefit (B)} = V \bullet M_{B\text{-}V} = [V_i]_{1\times n} \bullet [BV_{ij}]_{n\times m}$$

$$= [\text{B-1,B-2,...,V-m}]_{1\times m} \quad (2)$$

$$\text{Important degree of Products/services (PS)} = M_{B\text{-}V} \bullet M_{P/S\text{-}B}$$

$$= [Bj]_{1\times m} \bullet [PSBjk]_{m\times p}$$
$$= [\text{PS-1,PS-2,...,PS-p}]_{1\times p} \quad (3)$$

Herein, V_i denotes the important degree of i-th value, B_j denotes the important degree of j-th benefit and PS_k denotes the important degree of k-th products/services; BV_{ij} represents the affection degree for j-th benefits under i-th value and it will denote the count summation for j-th benefits under i-th value, PSB_{jk} the affection degree for k-th products/services under j-th benefit and it will denote the count summation for k-th products/services under j-th benefit. V_i can be directly obtained according to the ratio for the evaluation scale exceeding to 3.

The practitioners can obtain the useful information from the viewpoint of value expansion about the customers including the important items about value (V), Benefits (B) and Products/Services (P/S). It will aid the decision-making about marketing strategy, R and D and resource investment (Parry, 2002). Besides, the practitioners can match the new customer with the cluster of the regular customer and the useful recommendations including the R and D or marketing strategy to those new customers can be obtained by using the proposed approach.

THE ILLUSTRATIVE EXAMPLE

We will apply an illustrative example owing to leisure farming at Taitung area in Taiwan to demonstrate the rationality and feasibility of the proposed approach. During the past ten years, the managers of the leisure farming at Taitung area in Taiwan had gradually met a huge competitive pressure and they would like to effectively make decision about their resource reallocation or investment. As we known, from the viewpoint of the marketing management or management science, almost 80% profits will be derived from the 20% customers (Olson and Reynolds, 2001). The managers also recognized that lots of useful information will be hidden in their customers' behaviors. Hence, analysis of the customers will be a necessary study to be done. Therefore, a project team was grouped to perform such analysis. The detailed procedure was given as follows:

Stage I: Perform Kano two dimensions model to obtain the meaningful values: The Kano's two dimensions model will be applied to determine the meaningful values. Firstly, the project managers summarized the definition about customers' Values (V), possible Benefits (B) and Products/Services (P/S) via the previous marketing research reports which is made via many senior regular customers and senior managers. Seven customer's values, six benefits and sixteen P/S attributes were determined by those senior managers in this project. Then, a Kano's two dimensions questionnaire based on those seven possible values and an on-line questionnaire platform were constructed. The members of this leisure farming had requested to log in the platform in order to record their data. Those collected data will include the social attributes (the customers can keep it without any modification), the importance valuation of values, benefits, products/services, affection evaluation for benefit to value, Products/services to benefit, the evaluation for the value being sufficiently kept, the evaluation for the value being not sufficiently kept. Totally nine hundred forty-five members were included in this platform about 2 months.

Next, the project team performed the Kano's two dimension model analysis after collecting the customer's data based on the recommendation in Table 1. The analysis result will be given in Table 2. After reviewing Table 2, no any attractive values (A) were found. However, three Must-be (M) values were obtained including (1) keep health, (2) self-satisfactory and (3) leisure experience. Hence, in this illustrative example, three Must-be (M) values will be chosen to perform the subsequent value expansion analysis.

Stage II: Perform the values expansion analysis: At this stage, the customer clustering analysis will be initially performed. The social attributes including the

Table 2: The analysis result of the Kano's two dimensions model

	Category*					
Item	A	O	M	I	R	Option
Happiness and convenience	0.024	0.301	0.069	0.526	0.080	I
Keep health	0.099	0.238	0.413	0.038	0.212	M
Self-growth	0.013	0.340	0.028	0.599	0.021	I
Emotion communication	0.038	0.313	0.182	0.421	0.046	I
Self-satisfactory	0.133	0.057	0.514	0.229	0.067	M
Social contact	0.067	0.621	0.029	0.224	0.059	O
Leisure experience	0.131	0.098	0.670	0.042	0.058	M

*Each value in this table will denote the percentage value of each category for those seven values

Table 3: The comparison table of SOMNN

No. of cluster	Distbetw	Distin	Option
3	12.74	8.23	-
4	10.38	7.85	
5	9.64	8.95	

expectations of P/S, B and V with Likert Scale 5 will be viewed as the clustering variables to perform the clustering analysis. That is, there are nine input signals since performing SOMNN. Basically, too many clusters or too less clusters will not the manager's expectation. From the previous studies, there are no any standard rules determine the optimum number of cluster (NeuralWare, 1990; Hinton, 1989). However, the number of cluster can be determined according to the real consideration. Hence, we discussed with the senior managers to set the number of cluster as three from their expected analysis. That is, we will set the expected output signals to be three clusters. However, the managers also mentioned that the number of cluster can be changed depending on the related research result. In order to clearly hold the results for all possible clustering, we also took a suitable range of the number of cluster as 3 to 5. And the Euclidean distance function is then used to be viewed as an index of clustering analysis. Herein, we apply the Euclidean distance function to compute the average distance value ($DIST_{betw}$) between clusters and the average distance value ($DIST_{in}$) in the same cluster. If the larger average $DIST_{betw}$ value and the smaller average $DIST_{in}$ value can be possibly achieved, it can denote the chosen number of cluster will have no obviously bias effect on the real application. After running the SOMNN, the result was obtained in Table 3. From the result in Table 3, we can find out that the suitable number of cluster should set as 3.

Herein, we choose the third cluster to represent the construction of value expansion model. From the previous study, we had known that there are three customer's values (V), six benefits (B) and sixteen products/services (P/S) attributes. Those needed matrixes for this cluster will be constructed as follows:

Important degree of Value (V) = [keep health, self-satisfactory, leisure experience] = $[0.412, 0.193, 0.395]_{1\times3}$

Table 4: The important P/S attributes, benefits and values for three clusters

	Cluster			
Conected layers	No.	I	II	III
P/S attributes	1	P/S 2	P/S 15	P/S 12
	2	P/S 1	P/S 16	P/S 10
	3	P/S 3	P/S 1	P/S 3
	4	P/S 9	P/S 6	P/S 2
	5	P/S 12	P/S 2	P/S 11
	6	P/S 4	P/S 13	P/S 4
	7	P/S 10	P/S 12	P/S 13
	8	P/S 13	P/S 7	P/S 16
Benefits	1	Benefit 4	Benefit 1	Benefit 6
	2	Benefit 6	Benefit 5	Benefit 4
	3	Benefit 5	Benefit 3	Benefit 1
Values	1	Value 3	Value 2	Value 1
	2	Value 1	Value 3	Value 3
	3	Value 2	Value 1	Value 2

Herein, the important degree can be computed depending on the ratio of the customers with importance evaluation score exceeding 3.

$$\text{Matrix of benefit to value } (M^{T}_{B\text{-}V}) = \begin{pmatrix} 325 & 186 & \ldots & 33 \\ & & M & \\ 37 & 58 & \ldots & 100 \end{pmatrix}^{T}_{(3\times6)}$$

It can be computed to count the number of customers who had chosen the particular benefit with affection on values.

$$\text{Matrix of products/Sevices to benefit } (M^{T}_{P/S\text{-}B}) = \begin{pmatrix} 7 & 15 & \ldots & 33 \\ & & M & \\ 185 & 33 & \ldots & 59 \end{pmatrix}^{T}_{(6\times16)}$$

It can be computed to count the number of customers who had chosen the products/services attributes with affection on benefits.

Then, we can get that the important degree of benefit (B) and products/services (P/S). The partial computation can be denoted as follows:

Important degree of Benefit (B) = $V \bullet M_{B\text{-}V}$

= $[0.145, 0.102, \ldots, 0.266, 0.098]_{1\times6}$

Important degree of Products/services (PS) = $M_{B\text{-}V} \bullet M_{P/S\text{-}B}$

= $[0.085, 0.038, \ldots, 0.072, 0.036]_{1\times16}$

Finally, we can obtain the result about the value expansion of those three clusters and it will be represented in Table 4. Herein, the important items of benefits and the top 50% items of products/services will be chosen. From the result, the managers can hold value expansion information for all three clusters and the most

important items about products/services can be obtained as item 2, item 12 and item 13. And the items 1, 3, 4, 10, 16 will be also viewed as the important products/services items. Besides, the most important benefits derived from P/S attributes can be obtained as benefits 1, 4, 5, 6. We can find out the important P/S attributes can be mined by using the value expansion analysis. According to recognition about the senior employees at Leisure farming, they also agree with such findings. Then, the managers determined to pay more attentions to those three items and they try to make more resource allocation or investment to enhance the quality of those two items (But, it is not focus and it will not be represented in this study). Besides, mangers also find out marketing strategy for those different customer clusters according to Table 4.

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CONCLUSION

A value analysis procedure based on Kano's two dimensions model, SOMNN and value expansion model was developed in this study. And the feasibility and rationality of the proposed procedure can also demonstrated well by using a leisure farming case at Taiwanese tourism industry. Several concluding remarks or contributions can be obtained:

- Managers can realize the possible structure of customer segmentation about the regular customers by using SOMNN clustering analysis and it will let the managers know how to rationally and feasibly construct their corresponding competitive strategies
- The managers can also analyze the differences of values under different time period for the same customer cluster. It will aid the decision about the change of the marketing strategy and it will lead the managers to realize the real demands of market for addressing their supply
- A value expansion model which will link the products/services, benefits and values can be constructed well and can be modified according to the real consideration. It also let manager realize the possible relationship among those three layers in detailed.

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