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Application of Kansei Engineering and DEMATEL to Prioritize Service Quality for Public Hospital in Thailand

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Received 19 February 2018 ; Accepted 4 June 2018

Abstract

The health care industry is one of the rapid growth industries in Thailand. Thai government has promoted and set out a strategic policy to be ‘‘Medical Hub of Asia’’ since 2004. Therefore, the chief executive officers of many hospitals have determined strategies to improve their service quality because of the global competition. Service quality which refers to customer perceptions of the service process has been considered. Kansei Engineering can be the best tool for translating customer perceptions and emotions to the psychical desire attributes. This study conducted Kansei Engineering and service quality to analyze the relationships between service quality and customer’s emotion and feeling. Furthermore, the decision making trial and evaluation laboratory (DEMATEL) was employed to constructs the cause-effect relationship of criteria of the model that can be described complexity of causal relationships. The results show that tangible and empathy are the key factors that should be considered as the first priority for improving by public hospitals directors.

Keywords: Kansei Engineering; DEMATEL; Service Quality; Thailand Public Hospitals

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1. Introduction

Hospitals in Thailand have been promoted and set out a strategic policy to be ''Medical Hub of Asia'' since 2004 [1]. Many Thai hospitals have continuous improved their service quality to be high level offerings. Even though, Thailand is not to be developed countries such as Singapore, Japan and South Korea, but the technological infrastructure of Thailand's medical services have been the same quality as them. Thailand's medical tourism industry is one of projects to be promoted by increase number of foreign patients. The private hospitals have increased their specialized treatments such as beauty treatments and medical care for the elderly. However, the public hospitals have not improved and enhanced their service quality as the private hospitals because of lacking budgets, over load patients and so on. To be efficiency of limited budgets, the chief executive officers (CEO) have to seriously consider and decide to investing new projects or high-tech medical equipment and healthcare facilities. Therefore, service quality which refers to consumer subjective impressions of the service process has been interested and considered. Service quality is a tool for measuring the difference between customer expectations and perceived customer perceptions [2]. In addition, the public hospitals have focused to achieve customer satisfaction as a key point of their strategy. To know customer emotions and feelings is to be important for improving proper service quality.

Kansei Engineering is the best tool for translating the customer perceptions and emotion to the psychical desire attributes [3]. This technique was developed in 1970 by Nagamachi [3]. Most of Kansei Engineering researches have studied in designing for products but designing for services have not been widespread. Chen et al. [4] applied this method in home delivery service. Hartono [5] explored the service of luxury hotel. However, this method has to use the statistic to analyze the complicated relationships of emotions and psychical attributes.

The decision making trial and evaluation laboratory (DEMATEL) was developed to solve complex problems by the Battelle Memorial Association in 1973 [6]. It has been applied to solve causal relationship issues in many fields. For example, Chen [7] combined DEMATEL and ANP for the selection of airline service quality improvement criteria. Shieh et al. [8] conducted DEMATEL to in identify key success factors of Taiwan hospital service quality. Chenga et al. [6] applied the IPGA (Importance-performance and gap analysis) model and DEMATEL to explore the improvement priority of fine-dining restaurants. Tseng [9] employed Fuzzy theory and DEMATEL to prioritize the significant criteria in

hotels. Hu et al. [10] prioritized criteria in the communication equipment industry.

The purpose of this study is to prioritize service quality in Thailand's public hospitals using a combined multi-criteria decision-making (MCDM) model based on a decision-making trial and evaluation laboratory (DEMATEL) and Kansei Engineering which integrated DEMATEL and Kensei Engineering to analyze the interrelations among the evaluation criteria and service qualities in hospitals. Furthermore, DEMATEL has been used to develop the model of cause-effect relationship which criteria can describe the complex causal relationships [11]. This paper is organized as follows: Section 2 briefly reviews Kansei Engineering, service quality and DEMATEL method. Research process is represented in Section 3. A case study of Thai government hospitals is described and discussed in Section 4 and Section 5, respectively. Finally, conclusions are also described in Section 6

2. Theoretical Background

Kansei Engineering or Affective Engineering is proposed by Nagamachi for measuring customers' feelings and emotions and translating their perspectives to the product attributes [3]. This technique helps the product designers in various products such as in-vehicle rubber keypads [12], alarm clock made from bamboo [13] and chair forms [14]. In recent years, Kansei Engineering can be also employed to design the service attributes. For example, Chuan et al. [15] applied this method for sunglasses e-commerce shopping in Malaysia. Chen et al. [4] designed home delivery service with Kansei Engineering. Hartono [5] employed for luxury hotel. Hsiao et al. [16] conducted for the development of logistics service design in Taiwan.

2.1 Service quality

Service quality is a method for measuring the difference between customer expectations and customer perceptions [2]. SERVQUAL model or the measurement of service quality was introduced to analyze the key factors that require improvement in order to enhance quality. According to SERVQUAL model, there are five dimensions including reliability, tangibles, responsiveness, assurance and empathy. These service quality dimensions are as follows [7].

1) Tangible (Tan) refers to the appearance of physical facilities, equipment, personnel and materials.

2) Reliability (Rel) refers to employees' ability to promised service dependably and accurately.

3) Responsiveness (Res) refers to the willingness for helping customers and providing prompt service.

4) Assurance (Ass) refers to employees' knowledge and courtesy and their ability to inspire trust and confidence.

5) Empathy (Emp) refers to employees' individualized attention given to customers.

2.2 Decision-making trial and evaluation laboratory (DEMATEL)

DEMATEL is employed to construct the relationships between the significant customer emotions and service quality. It consists of 5 steps which are identified as follows.

Step 1: Calculating the original mean matrix (A)

After measuring the relationship between criteria which evaluate the perceived level of impact of each respondent, the original mean matrix can be calculated. The evaluation scale in pairwise comparisons of criteria ranges from 0 to 4, where 0 refers to no influence among criteria; 1 refers to low level influence; 2 refers to medium level influence; 3 refers to high level influence; and 4 refers to extremely high level influence [17]. The initial average matrix (A) is obtained by the average of the summation of the respondent answer matrices as shown in equation (1).This matrix represents the direct effects that criteria influence on and receive from other criteria.

$$A = [a_{ij}]_{p \times p} = (1/n)\ S\ x_{ij}^{k} \quad (1)$$

When

A = the original mean matrix

k = respondents with $0 \le k \le n$

x_{ij}^{k} = the degree of respondent rates factor i affects factor j

p = the number of factors

$0 \le i \le p,\ 0 \le j \le p$

Step 2: Calculating the normalized original mean matrix (D)

Firstly, the maximum summations of all rows or columns of the original mean matrix (A) are calculated. Next, the normalized matrix D can be obtained using equation (2) and equation (3). The normalized original mean matrix (D) is obtained by the following equation.

$$D = s \times A \quad (2)$$

$$s = \max S\ a_{ij} \quad (3)$$

Step 3: Calculating the total relation matrix (T)

The total relation matrix T is obtained by the following equation.

$$T = D\ (I - D)^{-1} \quad (4)$$

When

T = the total relation matrix

I = the identity matrix

Step 4: Calculating the total given effects and the total received effects

The mathematical equations (5) - (7) are employed for calculating the total given effects or the summation of column (D) and the total received effects or the summation of row (R).

Next, the summation of the total given effects and the total received effects (D + R) represents the total effects. The difference between the total given effects and the total received effects (D - R) represents the net effects as the cause–effect relationship. The importance effects of criteria are greater if the value of the total effects (D + R) is higher. In addition, the net causer factors are defined if the net effects higher than zero (D – R > 0). In contrast, the net receiver factors are defined if the net effects less than zero (D – R < 0) [18].

$$T = [T_{ij}]_{p \times p} \quad (5)$$

$$D = S\ T_j \quad (6)$$

$$R = S\ T_i \quad (7)$$

When

D = the total given effects
R = the total received effects
D+R = the total effects
D-R = the net effects

Step 5: Setting the threshold value and generating the causal relations diagram

A threshold value is set for filtering out some insignificant effects of the causal relationships. This value is defined by calculating the average of all values in the total relation matrix (T). Accordingly, the effects greater than the threshold value are chosen and shown in the causal relations diagram [8].

3. Research Methodology

Fig. 1 shows the methodology of this study that was adapted from [19]. The government hospital service quality was described by two different perspectives including the semantic perspective and the physical perspective. Then, both perspectives are described by customer emotion (we call ‘‘Kansei word’’) and the service quality (5 dimensions in SERVQUAL model). Subsequently, the interaction between these two perspectives is analyzed using DEMATEL which can map the causal relations diagram.

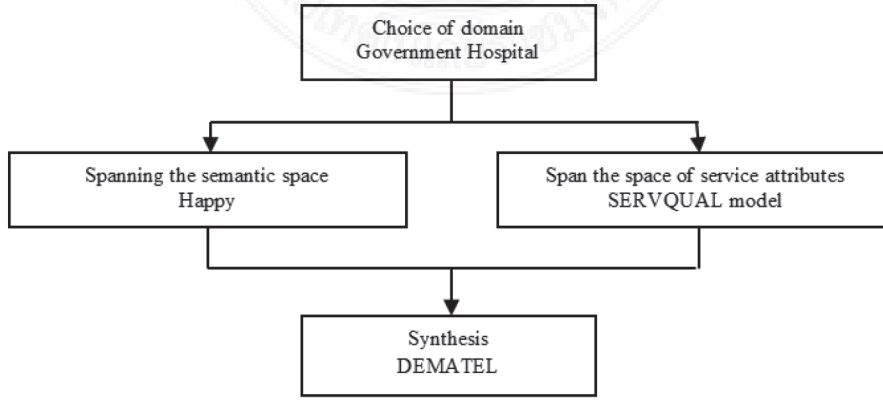

Fig. 1 Diagram of research process

3.1 Choice of domain

In this research, the public hospital service quality was selected as the domain of service attribute design. However, this study still in the initial step thus, the sample size was 30 respondents with simple random sampling. They were Thai people who have previous experience with the public hospitals that he or she had already frequently used. Our survey was done in 2 large public hospitals including Siriraj Hospital and Maharaj Nakorn Chiang Mai Hospital.

3.2 Spanning the semantic space

Kansei words or the customer emotions that meaning and information relate to service quality were selected through different sources such as internet, advertisements, and literature reviews. Six initial words as the six basic emotions (happy, anger, disgust, fear, sadness and surprise) were selected to discuss by an expert team. In brainstorming step, three lecturers who expert in product development and engineering management from Industrial Engineering Department, Rajamangala University of Technology Lanna (Thailand) discussed and ranked words that approximate to use in questionnaire. To approximate time for answer the survey, only one word is selected for the pairwise comparison questions. Happy was finally chosen as Kansei word in this survey because it is the positive emotion, whereas, the experts omitted the negative and vague emotions.

3.3 Spanning the space of service attributes

Five dimensions in SERVQUAL model chosen in this article were categorized to look at varying features as the importance criteria.

3.4 Synthesis

The questionnaire is constructed using the pairwise comparisons (five-point rating scale) as described in DEMATEL step. The causal relations diagram is generated to represent the mutual effects of the dimensions. The results show the key factors that the public hospitals should concentrated as well as the insignificant factors that are ignored from hospital management' viewpoints.

4. Results

4.1 Descriptive statistics

From 30 participants, more than half (58%) were male, in age, 20 to 30 year-olds (62%), in education, have university degrees (64%), in occupation, student (62%), in marital status, single (83%), in monthly income, less than 15,000 baht (70%). Most of the participants went to hospitals once a year (65%) as shown in **Table 1**.

4.2 Kansei Engineering and DEMATEL analysis results

The causal relations diagram of the service quality of the public hospitals in Thailand was constructed using

DEMATEL method. According to Kansei word "Happy", the original mean matrix (A) from the opinions of 30 participants was calculated using equation (1) as shown in **Table 2**. From this table, Tan is the highest degree of impact on Rel (3.415), whereas, Res is the lowest low degree of impact on Tan (1.220).

According to equation (3), the maximum value of the summations of all rows and columns of the original mean matrix (A) is calculated as the value of 12.698 (s = 3.368 + 3.386 + 3.458 + 2.486 + 0.000) from the sum of the rows of Emp. The normalized original mean matrix (D) is shown in **Table 3**. For this example, the normalized of Tan – Rel is 0.269 (=3.415/12.698).

The total relation matrix (T) is obtained using equation (4) as shown in **Table 4**. For this example, the total relation of Tan – Rel is 3.945 (= 3.415/ 1.155; D=3.415; $(I - D)^{-1}$=1.155). The threshold value was 1.907 by using the average of all values in matrix T. The criteria that higher than the threshold value are significantly effect on another one, such as Tan is the important given effect on Rel which value of 3.415.

Next, the summations of values in rows and columns are the total given effects (D) and the total received effects (R), respectively, as shown in **Table 5**. For this example, the total given effects

Table 1 Descriptive statistics

Variable	Percent (%)	Variable	Percent (%)
Gender		**Occupation**	
Male	58	Student	62
Female	42	Public servants	3
Age		Employees	13
Below 20 years	2	Private business	10
20 – 30 years	62	Unemployed	12
31 – 40 years	22	**Monthly income (THB)**	
41 – 50 years	10	≤ 15,000	70
51 years and over	4	15,001- 25,000	22
Education level		25,001- 35,000	5
Under university	35	35,001- 45,000	2
University degree	64	> 45,001	1
Post graduate	1	**Frequency of used public hospital (per year)**	
Married status		Once a year	65
Single	83	Twice a year	25
Married	17	More than	10

of Tan is 13.229 (=0.000+3.945+3.615+ 3.249+2.420). This table can describe the direct and indirect effects of five criteria. According to the total effects (D+R), T is the dimension of the highest priority in service quality of Thai government hospitals, whereas, Res is the dimension of the lowest priority in the matrix. The importance of service quality can be prioritized as Tan > Emp > Ass > Rel > Res. Similarly, the net effects (D-R) indicates the cause-effects of the total relation matrix. For example, the net effects of Tan (5.181) is higher than zero that means T is the net causer factor. On the other hand, the net effects of Rel (-7.036) is less than zero that means Rel is the net receiver factor. Therefore, the digraph of these five criteria is draw by plotting the coordinate values of each criteria into a scatter plot as shown in **Fig. 2**.

Table 2 The original mean matrix (A) of Kansei word ''Happy''

Dimension	Tangible (Tan)	Reliability (Rel)	Responsiveness (Res)	Assurance (Ass)	Empathy (Emp)
Tangible (Tan)	0.000	3.415	3.267	3.142	2.846
Reliability (Rel)	2.168	0.000	2.286	2.412	1.400
Responsiveness (Res)	1.220	2.111	0.000	2.415	1.768
Assurance(Ass)	2.940	3.302	2.605	0.000	2.118
Empathy(Emp)	3.368	3.386	3.458	2.486	0.000

Table 3 The normalized original mean matrix (D)

Dimension	Tangible (Tan)	Reliability (Rel)	Responsiveness (Res)	Assurance (Ass)	Empathy (Emp)
Tangible(Tan)	0.000	0.269	0.257	0.247	0.224
Reliability(Rel)	0.171	0.000	0.180	0.190	0.110
Responsiveness (Res)	0.096	0.166	0.000	0.190	0.139
Assurance(Ass)	0.232	0.260	0.205	0.000	0.167
Empathy(Emp)	0.265	0.267	0.272	0.196	0.000

Table 4 The total relation matrix (T)

Dimension	Tangible (Tan)	Reliability (Rel)	Responsiveness (Res)	Assurance (Ass)	Empathy (Emp)
Tangible(Tan)	0.000	3.945*	3.615*	3.249*	2.420*
Reliability(Rel)	1.475	0.000	1.784	1.792	0.795
Responsiveness (Res)	0.714	1.575	0.000	1.675	0.970
Assurance(Ass)	2.558*	3.448*	2.526*	0.000	1.558
Empathy(Emp)	3.301*	3.914*	3.876*	2.492*	0.000

* refers to value greater than the threshold value (1.907)

Table 5 The total given effects and the total received effects

Dimension	The total given effects (D)	The total received effects (R)	The total effects (D+R)	The net effects (D-R)
Tangible(Tan)	13.229	8.048	21.277	5.181
Reliability(Rel)	5.846	12.883	18.729	-7.036
Responsiveness (Res)	4.934	11.801	16.735	-6.867
Assurance(Ass)	10.090	9.207	19.297	0.882
Empathy(Emp)	13.583	5.743	19.326	7.840

5. Discussion

In the DEMATEL model, the total effect of tangible is the highest effect and has effected to others. The total effect of empathy is the second value and also has impacted as same as tangible. According to Kansei word of Happy, tangible and empathy are the most important service quality dimensions that should be the first priority for improvement or investment in terms of the development strategy by directors of Thailand's public hospitals. In addition, these criteria are highest effects and have directly influenced on other service quality dimensions. Yousapronpaiboon and Johnson [20] compared service quality between private and public hospitals in Thailand. Their results represented the public hospitals should improve in the areas of creating a visually appealing environment and physical facilities within hospital. This service attribute was one of service quality in tangible dimension. In contrast, event though, reliability and responsiveness are

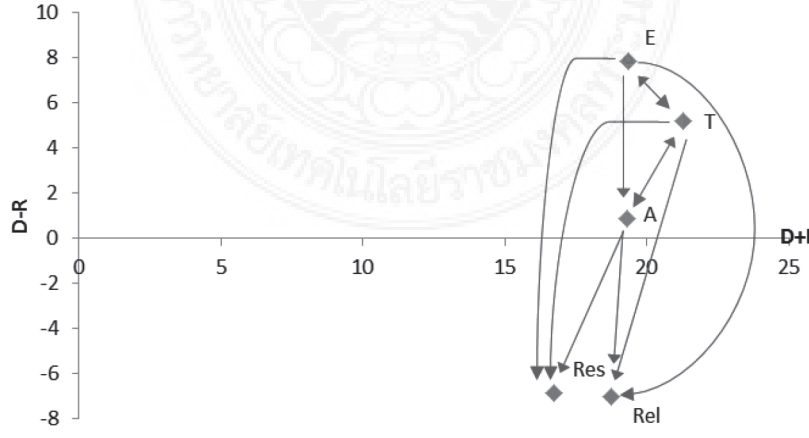

Fig. 2 The causal relations diagram

insignificant factors in customer emotions and feelings and do not effect on other factors, these service quality dimensions should not ignore from CEO as trusted medical staff with professional competence of health care is the most important factors of hospital service quality in Taiwan [8].

6. Conclusion

This study conducted DEMATEL and Kansei Engineering to prioritize service quality in public hospitals in Thailand. Five service quality dimensions in SERVQUAL model including reliability, tangibles, responsiveness, assurance and empathy are identified with the customer perception as the chosen emotion of "Happy". DEMATEL method can determine the importance of five service quality. The causal relations diagram is generated to represent the mutual effects of the dimensions. The results show that tangible and empathy are the key factors and the public hospital directors should be the first priority for improvement or investment in terms of the development strategy by directors of public hospitals. Therefore, the appearance of physical facilities, equipment, personnel and materials should be improving because customers think good tangible is the basic requirement**.** Similarly, the employees' individualized attention given to customers is also urgent requiring improving to satisfy customer demands. In contrast, reliability, responsiveness and assurance are belonging to the low priority area. However, these dimensions should be also considered to continuous improving.

Because of limiting in budget, only 30 participants in Chiang Mai and Bangkok were chosen in this survey. In future work, we may focus on other regions or the in-depth criteria of service quality.

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