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PROCEEDINGS BOOK

Sustainable Technology and Innovation:
Opportunities and Challenges

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InCITE 2017

INTERNATIONAL CONFERENCE ON INFORMATICS, TECHNOLOGY AND ENGINEERING 2017

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PUBLISHER:
LPPM UNIVERSITAS SURABAYA

ISBN:
978-602-73416-8-5

Faculty of Engineering - Universitas Surabaya

InCITE 2017

PROCEEDING BOOK OF INTERNATIONAL CONFERENCE ON INFORMATICS, TECHNOLOGY AND ENGINEERING 2017

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A collaborative activity jointly organised by:

UBAYA UNIVERSITAS SURABAYA
NTUST
SERC
UNIVERSITY OF WOLLONGONG AUSTRALIA

InCITE 2017

INTERNATIONAL CONFERENCE ON INFORMATICS, TECHNOLOGY AND ENGINEERING 2017

24-25 AUGUST 2017

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An integrative fuzzy Kansei Engineering and Kano model for logistics services

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Abstract. Nowadays, customer emotional needs (known as Kansei) in product and especially in services become a major concern. One of the emerging services is that logistics services. In obtaining a global competitive advantage, logistics services should understand and satisfy their customer affective impressions (Kansei). How to capture, model and analyze the customer emotions has been well structured by Kansei Engineering, equipped with Kano model to strengthen its methodology. However, its methodology lacks of the dynamics of customer perception. More specifically, there is a criticism of perceived scores on user preferences, in both perceived service quality and Kansei response, whether they represent an exact numerical value. Thus, this paper is proposed to discuss an approach of fuzzy Kansei in logistics service experiences. A case study in IT-based logistics services involving 100 subjects has been conducted. Its findings including the service gaps accompanied with prioritized improvement initiatives are discussed.
Keywords: Kansei Engineering; fuzzy; logistics services

1. Introduction

Research on Kansei Engineering (KE) is of high interest due to the increase of customer expectation in terms of emotional needs and satisfaction. Its application in services becomes more and more critical since many service companies provide offerings with almost the same quality, price and delivery service. Surely, it makes confusion to customers in deciding which product or service they need to choose and buy. Hence, it needs something to differentiate and superior among all provided criteria. One of the most prominent consideration in making successful transaction is that emotional satisfaction and impression (known as Kansei, in Japanese) [1]. According to Hartono & Raharjo [2], both cognitive and affective satisfaction (known as Kansei and Chisei) are important in service-related encounters. In other words, it can be said that cognitive requirement should be fulfilled first, and then it moves to the realization of Kansei.

KE has been proven as one of the most powerful ergonomics-based product and also service development methodologies, incorporating emotional needs. According to Hartono [3; 4], with regard to service application, it covers but not limited to general KE methodology, SERVQUAL and Kano model embedded [1; 5; 6; 2; 3], cultures [6; 3], TRIZ (*Teoriya Resheniya Izobretatelskikh Zadach*) methodology [3; 4], and sustainability approach [7; 4].

In judging whether a particular service is emotionally appeal or not, customer delight is regarded as the most prominent criterion. It refers to customer experience and interaction, rather than just service offering without any interventions. It starts with the gap between what has been expected and

perceived by the customer. It is a measure of customer satisfaction based on the service quality. However, quality itself is not enough. Service quality should be strengthen by total customer satisfaction and delight [8]. Recent studies of KE show that Kano model has been successfully integrated into KE methodology, in order to achieve more efficient improvement strategies (see [1] for details). Furthermore, it has been extended by incorporating the issue of sustainability and TRIZ methodology [see 3; 4]. Its objective is that to contribute to the solution for today's issue, yet to maintain the efficiency of proposed methodology. For instance, the use of TRIZ is to provide problem-solving principles to resolve any contradictions. More specifically, according to Hartono [3; 4], TRIZ is used to generate ideas for improvement with the possible lowest contradiction among them.

Inherently, the attention on the reliable and valid perceived service quality and Kansei has been raised. With respect to customer emotional satisfaction, KE has shown its superiority against some similar methodologies. However, it might have missed its capability in modeling exact values of perceived customer impression. A criticism of perceived scores on user preferences has been occurred [9]. In this study, it may refer to both perceived service quality and Kansei responses. In other words, it lacks of the attention on customer dynamics. Hence, this paper discusses an approach of fuzzy Kansei in logistics service quality, accompanied by an empirical study on IT-based supporting logistics services. The Kano model is engaged in order to strengthen KE methodology in focusing more on delighting service attributes (see [1] for details).

This paper consists of 5 main parts. After the introduction section, a short literature review on fuzzy in Kansei and SERVQUAL, and Kano model in logistics services is provided. Afterwards, research methodology and an empirical study on IT-based supporting logistics services, followed by analysis and discussion are presented. The last section will be conclusion and future recommendation.

2. Literature review

2.1. Fuzzy in Kansei and SERVQUAL

According to Hartono & Tan [1], KE in services is defined as the methodology which takes into account the customer emotional needs (known as Kansei) and translates them into service design and development. Since Kansei is a function of design characteristics/attributes [10], the spanning followed by selection and evaluation of service attributes is critical. More specifically, what service attributes affect most to many Kansei will be of high interest, and followed up by either continuous improvement or enhancement.

KE as the backbone of this recent study has been considered to be superior against other similar method. This method provides some remarkable advantages [5], such as ability to translate emotional needs into concrete design parameters, ability to build mathematical model to minimize subjectivity, ability to optimize the intangible properties which are dealing with significant feelings, and to showcase the relationship model of cognitive and affective process.

The generic model of service attributes which is deemed to be the predictor for Kansei refers to SERVQUAL dimensions [1]. In the future Kansei type, it may refer to Kansei quality management. It is defined as KE methodology taking into account customer emotional needs in service design and development to maximize total customer satisfaction. It is expected to serve consistent Kansei at all interaction-based service processes (e.g., reception, offering, and post-purchase) [8]. In achieving that consistency, service quality control is needed. It starts with the identification of service gap, and the magnitude of service satisfaction.

The challenge for Kansei research is that its dynamics. How to make Kansei consistent or to judge whether it is still relevant in any particular service encounters over time is so challenging. A study on the evaluation of perceived Kansei and service performance in the steady state has been conducted by Hartono et al. [5]. It showed, for example, some Kansei words were deemed to be important since they had a very little gap between their perceived value in the current and future state. Therefore, in practical point of view, these potential Kansei words should be maintained over time, and more importantly, to what extent they were connected to particular service attributes. Given a very limited

resources, this study was hoped to provide practical contribution in terms of prioritized improvement strategies. However, an intensive attention on this research field is less explored. Another concern is occurred, which is a critics on how to get the exact values of Kansei and perceived services. Once the user says a particular attribute performance is good, then a question is raised "How good it is? Is it applied to all actual users? Does it show a score of 4, or 4.5 or 5?" Hence, it comes to the concept of fuzzy taken into account in evaluating both Kansei and service performance.

2.2. Kano model as a catalyst

Kano model has simplified the service or product performance into three main categories, namely, basic/must-be (M), linear/one-dimensional (O), and delighting/attractive (A). Kano's M category is a must, a provision of basic features of product or service in which not give any significant satisfaction once it is improved dramatically [11]. In KE studies, especially in services, Kano is utilized to strengthen the KE methodology by shorten its prioritized improvement steps (see [1]). Thus, Kano's O and A are regarded as the prominent categories dealt with Kansei. More than the better performance, the higher the customer satisfaction is. It discusses more on delighter, which is beyond expectation. Since most customers have not realized their attractive needs, it is so relevant to engage Kano's A category into Kansei-based service design or development. Schütte [12] mentioned that Kano's attractive feature is closely connected to affect.

Kano model shows its flexibility and capability to be engaged with other quality-based tools/methods for product and service designs. The idea of considering fuzzy mode on Kano categorization, for instance, related to QFD on product management has been developed by Lee et al. [13]. Kano has been treated to be more objective in the course of weighing. Another study by Lopez and Jeronimo [14] proposed a Kano model incorporated fuzzy distances and 2-tuple fuzzy-linguistic model to manage a more efficient and effective logistics services.

With respect to Kansei-based service improvement strategies, Kano serves as a catalyst. Referring to the definition of catalyst, the involvement of Kano in KE methodology increases the efficiency and effectiveness of the formulized improvement strategies. In logistics services, as one of the emerging services nowadays, the contribution of Kano model in KE methodology is expected to be promising.

3. Research Methodology

Survey method through personal interview and face-to-face questionnaire were used for data collection, considering the effectiveness of interaction between respondents and the interviewer. Also, this type of method promotes clarification on ambiguous questions and doubts effectively and efficiently. Purposive sampling (known as judgment sampling) was utilized to select subjects or respondents. Those respondents were chosen by the judgment of the researcher [15].

A questionnaire has been prepared and tested through a pilot study. Only one copy of the questionnaires was targeted for one group of participants. One group can be one single respondent or one family. Approximately, it took about 15 minutes to complete one questionnaire [1].

4. Empirical Study and Discussion

According to Hartono & Tan [1], this study followed the steps as discussed and shown in Figure 1. It started with the choice of logistics services domain. It is, then, followed by the measurement of perceived Kansei and SERVQUAL, and the incorporation of fuzziness as the basic contribution. A membership function of triangular fuzzy number (TFN) will be used. Kano categorization will take place to enhance the efficiency of perceived SERVQUAL which is more focused on Kano's A and O category. Afterwards, the gap between perceived and expected services will be measured, and followed by customer satisfaction score for determining prioritized improvement strategies.

A case study on logistics services of company named "ABC" has been conducted. Those who were experienced services (i.e., there were 23 logistics service items; these were services aiming to deliver goods or documents to particular destinations) from this company at least once in a month within January 2016 – December 2016 were targeted and selected as the potential subjects. In total, there

were 100 subjects collected (43% male, 57% female; 45% ranged 21-25 years old; 54% working in private sector).

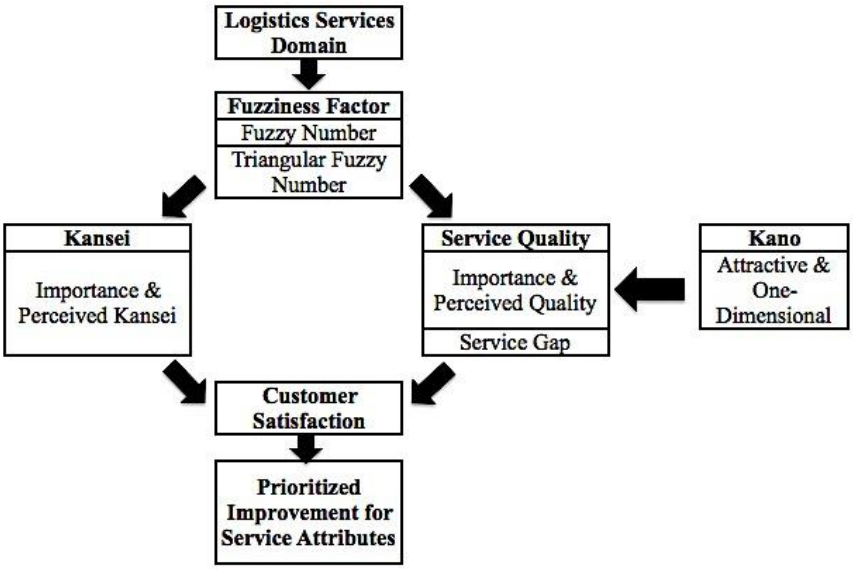

Figure 1. Application framework of fuzzy KE and Kano model in logistics services.

5. Result and Discussion

According to Stefano et al. [9], the assessment of customer satisfaction in services is derived from what has been expected and perceived by customer. It is when conventional ordinal scales applied. Due to criticism on the appropriateness of scales used [9], by taking into account exact preference judgment shown in an exact numerical value, fuzziness factor has been applied. Taking a case study on IT-based logistics services, this study used linguistic variables in rating perceived and expected service quality and perceived Kansei scores, consisted of "very low, low, fair, high, very high" for expectation, and "very poor, poor, fair, good, very good" for perception. Afterwards, those linguistic variables were converted into triangular fuzzy numbers (as shown in Table 1).

Table 1. Linguistic variables and triangular fuzzy numbers.

Scale	Linguistic variable (expectation)	Linguistic variable (perception)	Triangular fuzzy numbers
1	Very low	Very poor	{1.19; 1.56; 2.16}
2	Low	Poor	{2.97; 3.86; 4.63}
3	Fair	Fair	{5.66; 6.54; 7.27}
4	High	Good	{8.16; 9.00; 9.67}
5	Very high	Very good	{10.37; 11.20; 11.96}

Considering the fuzzy numbers, the mean of expected and perceived scores of service quality and also the service gap have been calculated, and provided in Table 2. It shows that the attribute "office waiting room" had the highest gap. Afterwards, through linear mathematical modeling of Kansei as the function of perceived logistics attributes with Kano's O and A category, it has been found that (see [1] for the details of weighting process of Kano and Kansei scores into particular service attributes] the attribute "politeness of staffs" showed the greatest importance weight [see Table 3]. Given a very limited resource in terms of budget, time and effort, this company "ABC" should put more concern on the improvement of the attribute "politeness of staffs". In other words, the attribute of politeness of staffs was deemed to be a very sensitive to the customer emotional satisfaction.

Table 2. Expected and perceived service gap.

Dimension	Label	Logistics service attributes	Expected	Perceived	Gap
Tangible	T_1	Uniform for staffs	9.226	7.277	-1.949
	T_2	Appearance of staffs	8.536	6.800	-1.736
	T_3	ID for staffs	9.588	6.961	-2.627
	T_4	Cleanliness of office counter	9.487	6.916	-2.571
	T_5	Interior of office	8.498	6.302	-2.196
	T_6	**Office waiting room**	9.621	6.787	**-2.834***
Reliability	RL_7	Condition of transportation vehicles	8.892	7.527	-1.365
	RL_8	Promptness of service	10.391	7.966	-2.425
	RL_9	Accuracy of delivery	10.802	9.340	-1.462
	RL_{10}	Lead-time of delivery	10.440	8.261	-2.179
	RL_{11}	Tracking system	9.998	8.450	-1.547
Responsiveness	RP_{12}	Accuracy of tariff	10.011	9.272	-0.738
	RP_{13}	Responsiveness to any problems	10.070	8.069	-2.001
	RP_{14}	Availability of staffs	9.763	8.310	-1.453
	RP_{15}	Completeness of service given by staffs	10.406	9.065	-1.341
	RP_{16}	Clarity of information given by staffs	10.315	8.524	-1.792
Assurance	A_{17}	Security of parking lot	9.976	8.226	-1.749
	A_{18}	Discrepancy of packet/good delivered	10.530	8.829	-1.702
	A_{19}	Readiness of transportation vehicles	9.338	8.210	-1.128
Empathy	E_{20}	Hospitality of staffs	9.868	7.912	-1.956
	E_{21}	Politeness of staffs	9.964	8.389	-1.575
	E_{22}	Proactiveness of staffs	9.560	7.410	-2.150
	E_{23}	Apology raised by staffs	9.506	7.510	-1.996

**it shows the highest service gap*

Table 3. Weighted importance score for logistics service attributes.

Logistics services attributes	Label	|Satisfaction score|*	Kano category and weight		Kansei word and score		Weighted importance score**
ID for staffs	T_3	23.828	O	2	Friendly	6.323	301.3
Cleanliness of office counter	T_4	22.574	O	2	Prompt	6.900	1,063.7
					Secured	9.698	
					Tidy	6.963	
Promptness of service	RL_8	25.224	A	4	Calm	6.301	635.7
Accuracy of delivery	RL_9	15.684	A	4	Prompt	6.900	829.6
					Friendly	6.323	
Clarity of information given by staffs	RP_{16}	18.497	A	4	Calm	6.301	466.2
Security of parking lot	A_{17}	17.556	A	4	Secured	9.698	2,621.0
					Happy	6.958	
					Tidy	6.963	
					Comfortable	6.465	
					Accurate	7.240	
Discrepancy of packet/good delivered	A_{18}	17.749	A	4	Comfortable	6.465	458.9
Hospitality of staffs	E_{20}	19.188	A	4	Friendly	6.323	485.3
Politeness of staffs	E_{21}	15.159	A	4	Secured	9.698	**2,626.4****
					Interesting	5.913	
					Satisfied	7.200	
					Calm	6.301	
					Tidy	6.963	
					Accurate	7.240	
Proactiveness of staffs	E_{22}	20.285	O	2	Secured	9.698	1,181.1
					Interesting	5.913	
					Satisfied	7.200	
					Calm	6.301	
Apology raised by staffs	E_{23}	18.794	A	4	-	-	75.2

*|satisfaction score| = importance level x gap
**weighted importance score = |satisfaction score| x Kano weight x number of significant Kansei x Kansei score
***it shows the highest importance weight

Following up the critical service attribute of politeness of staffs, this company "ABC" can promote training for staffs regarding personality and teamwork building which always brings value on customer focus.

6. Conclusion, limitation and future recommendation

This study provides a grounded framework of how to fulfill customer emotional needs (known as Kansei) in logistics services by taking into account fuzzy-based KE methodology equipped with Kano model. Practically, given a very limited resource, this study provides guidance to service manager in improving prioritized logistics service attributes with higher degree of certainty.

Due to very limited sample size and only tested in IT-based logistics services, this model of fuzzy-based KE and Kano model should be applied into other logistics services. Involving more samples is also encouraged.

References

[1] M Hartono and K C Tan 2011 How kano model contributes to kansei engineering in services *Ergonomics* vol **54** no **11** pp 987-1004
[2] M Hartono and H Raharjo 2015 Exploring the mediating role of affective and cognitive satisfaction on the effect of service quality on loyalty *Total Quality Management & Business Excellence* vol **26** no **9-10** pp 971-985
[3] M Hartono 2016 The extended integrated model of kansei engineering, kano, and TRIZ incorporating cultural differences into services *International Journal of Technology* vol **7** no **1** pp 97-104
[4] M Hartono 2016 A conceptual integrative model of kansei engineering, kano and TRIZ towards sustainability in services in *Proceedings of 8th Widyatama International Seminar on Sustainability*, Bandung, Indonesia
[5] M Hartono 2012 Incorporating service quality tools into kansei engineering in services: A case study of indonesian tourists *Procedia Economics and Finance* vol **4** pp 201-212
[6] M Hartono, K C Tan and J B Peacock 2013 Applying kansei engineering, the kano model and QFD to services *International Journal of Services, Economics and Management* vol **5** no **3** pp 256-274
[7] F Rasamoelina, C Bouchard and A Aoussat 2013 Towards a kansei-based user modeling methodology for eco-design *International Journal of Affective Engineering* vol **12** No **2** pp 337-348
[8] M Nagamachi and A M Lokman 2011 Innovations of kansei engineering *Boca Raton: CRC Press*
[9] N M Stefano, F N Casarotto, R Barichello and A P Sohn 2015 A fuzzy SERVQUAL based method for evaluated of service quality in the hotel industry *Procedia CIRP* vol **30** pp 433-438
[10] M Nagamachi 1995 Kansei engineering: A new ergonomic consumer-oriented technology for product development *International Journal of Industrial Ergonomics* vol **15** pp 3-11
[11] N Kano, N Seraku and F Takahashi 1984 Attractive quality and must be quality *Quality* vol **14** no **2** pp 39-44
[12] S Schütte 2005 Engineering emotional values in product design kansei engineering in development *Thesis Linkoping University*, Linkoping
[13] Y-C Lee, L-C Sheu and Y-G Tsou 2008 Quality function deployment implementation based on fuzzy kano model: An application in PLM system *Computer and Industrial Engineering* vol **55** no **1** pp 48-63
[14] R F Lopez and J M R Jeronimo 2012 Managing logistics customer service under uncertainty:

An integrative fuzzy kano framework *Information Sciences* vol **202** pp 41-57
[15] K Black 2010 *Business Statistics: Contemporary Decision Making* **6** John Wiley & Sons