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Kansei-based Mining and Robust Design for Internet Service Provider

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Abstract – **Customer emotional satisfaction (known as Kansei) and retention is deemed to be vital for all service businesses including for the high-tech services such as Internet Service Providers (ISPs). Functionality and usability attributes such as network quality and connection speed are regarded as basic requirement. However, there has been little attention and academic research to evaluate the importance of perceived ISPs' service quality on customer emotional need and satisfaction (Kansei). Hence, more Kansei-based offerings are required as more service performance and delivery to obtain customer emotional satisfaction. Moreover, due to customer dynamics, more representative Kansei and robust solution are expected. This study discusses how Kansei-based mining design is proposed and enhanced by Taguchi methodology for robustness of improvement strategy. Both theoretical and practical implications are discussed.**

Keywords - **Kansei, mining, robust, ISPs**

I. INTRODUCTION

Nowadays Internet Service Provider (ISP) should provide more comprehensive service offerings, not just a good internet connection, but also how to be more customer-oriented attributes. The quality of network, information, private connection, and speed are found to be prominent factors of internet provider service quality. Instead of direct contact with customer service, the information support is deemed to be more important attribute of ISP [1]. In Indonesia, there were 400 ISPs by year 2020 (www.statista.com).

In this era of globalization, the use of the internet has become a primary need for some people. This is in accordance with technological developments and the ease of access in various things in everyday life. This can be seen in the provision of internet facilities in almost all businesses and homes. Therefore, many companies have started to build businesses as internet service providers to meet the needs of internet use in society. In Indonesia, there are many internet providers, both in the form of wireless connectivity (wi-fi) or those that only use LAN cables (fixed broadband).

In measuring service quality, SERVQUAL was intensively used [2]. Related to online service quality, E-S-QUAL is introduced [3]. Nevertheless, the modification of SERVQUAL according to specific contexts is still relevant. Study by Quach et al [1] tried to measure the impact of perceived ISP service quality on customer behavioral intention using the modification of service attributes. They include the constructs of network, information, service, security and privacy, complaint intention, switching intention, and repurchase intention.

Although it is rationale to assume that perceived service quality plays significant role in customer satisfaction and behavioral intention in the high-tech services such as ISPs, there has been little attention and academic study to evaluate the importance of perceived ISPs' service quality on customer emotional need and satisfaction (Kansei). More specifically, the Kansei mining for the domain of internet service quality will offer distinctive contribution. On the other words, functionality and usability only are insufficient in achieving the entire experience and satisfaction of customers in ISPs. Hence, a more holistic approach by engaging emotional satisfaction is promoted, which is related to Kansei [4, 7].

This study focuses on the importance of Kansei due to perceived service quality of ISP. Kansei is the representative of customer emotional need and satisfaction, as a linear function of perceived product or service quality attributes [4, 5, 6]. It is, however, challenging to obtain Kansei which is quite representative and robust. According to Hartono [7], apart from traditional approaches in gaining Kansei (such as through literature review, ethnography, and survey), a deep question is raised. How do we collect Kansei accurately and then match it with the service design characteristic? We will utilize and modify the Kansei mining addressed by Hartono [7] taking into account a case study on ISP in Indonesia, named as XYZ. In 2020, this company XYZ wants to further strengthen its position as a fixed broadband market leader with a target of 8.3 million subscribers and revenue growth of up to 20 percent. This company will accomplish it through improving customer service, product innovation and offering various attractive programs that improve the quality of the customer's digital experience. Regarding the improvement of customer service, this company continues to make the improvement towards one day service, so that the customers do not have to wait long for technicians to handle. In addition, the company also wants to implement innovations to make it easier for customers to pay bills through various billing payment points.

Hence, this study has an objective of applying the Kansei-based mining methodology for improving the ISP service quality. Both theoretical and practical implications are discussed.

II. BRIEF LITERATURE REVIEW AND FRAMEWORK DEVELOPMENT

Emotional need and satisfaction (known as Kansei) is one of human aspects which is very crucial in the human system interaction. It includes product and service interaction. Kansei is set to be a linear function of perceived service quality attributes. The inclusion of Kansei in the service design and interaction will increase customer satisfaction. Compared to other similar methods, Kansei in the Kansei Engineering (KE) methodology shows its superiority in terms of how it capture, identify, map, and refine the emotional needs of customer towards service design and development [6, 7]. One of significant strengths of KE methodology is that its flexibility to engage with other methods/techniques (such as SERVQUAL, TRIZ, and Kano model) and also to be applied in different service contexts (such as logistics, culture, sustainability, hotel, restaurant, mining process, robust design).

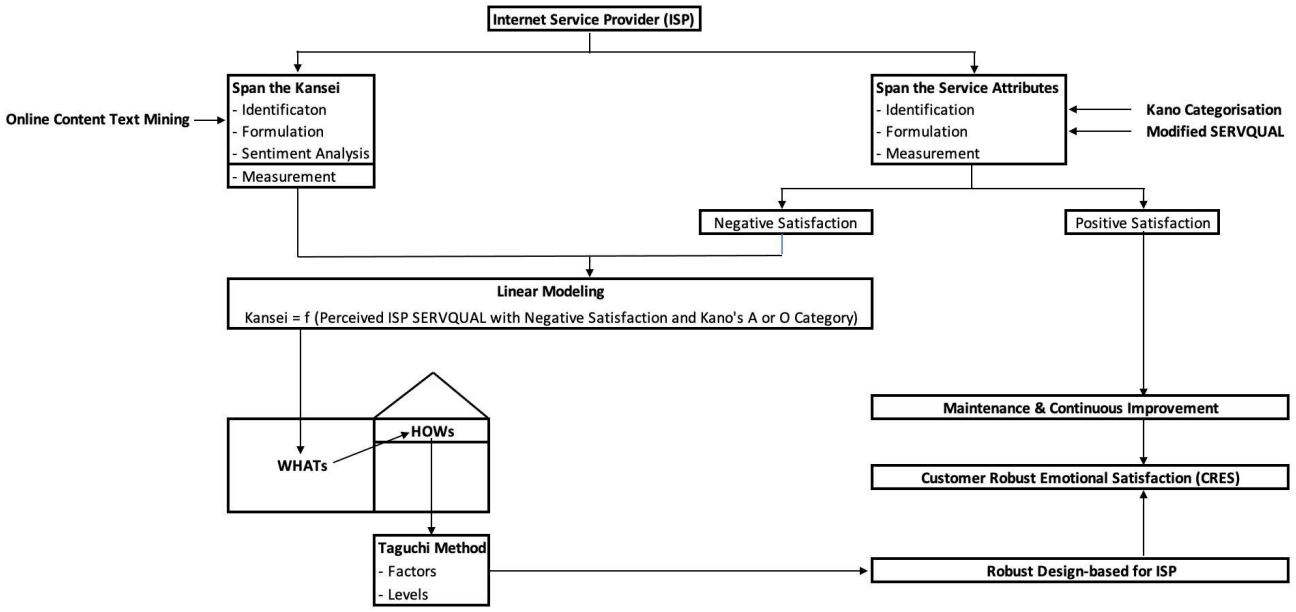

Fig. 1. Application framework of Kansei-based mining methodology for ISP service design

However, it is challenging how to get representative Kansei. Hence, Kansei mining process is proposed. Then, how to get correct and representative Kansei is crucial. Due to various linguistic cultures and differences in service contexts, Kansei words as the representative emotional needs are sometimes not valid. The same Kansei words may have different tone, amplitude, and even meaning. The collected Kansei words may be short-lasting and imprecise.

Recalling the case on internet services, what Kansei words are appropriate. Perhaps the Kansei "fast", "clear", and "happy" are presumed to be appropriate. How to convince that they are true? It is critical attributes will be discussed in this study.

Referring to the proposed application framework of Kansei-based mining methodology for ISP service design as shown in Fig. 1 above, apart from Kansei mining methodology, the modified SERVQUAL attributes are proposed. In the case of ISP, both tangible and intangible dimensions of SERVQUAL are needed. The tangible attributes may include infrastructure and equipment of internet connection such as downloading or uploading speed, staff's uniform, and supporting facility for signal stability. Whereas the intangible dimensions may refer to responsiveness, reliability, assurance, and empathy of service quality. Kano model is then used to filter the ISP attributes into 3 main categories, i.e., basic/must-be (M), one-dimensional/linear (O), and attractive/delighter (A). Regarding this categorization, please refer to research by Hartono & Tan [11]. Using a formula of satisfaction is equal to perception minus expectation, linear modeling mechanism is done. This linear model is set using linear regression analysis with perceived Kansei as dependent variable and perceived ISP SERVQUAL attributes with negative satisfaction score and Kano's A or O category as independent variables.

Once the linear model is set, a mechanism for improvement strategy is proposed. The critical ISP service attributes are identified and set as WHATs, followed by the improvement strategies (known as HOWs) using House of Quality (HoQ). Afterward, the Taguchi method with factors and levels is applied in order

to obtain the robust design-based for ISP service quality.

III. METHODOLOGY

This study took a case study in one of the biggest ISPs in Indonesia, named as company XYZ. Online interview and survey through questionnaire were used to data collection process. Company XYZ is a provider of internet, landline telephone and interactive television services. It is also one of the service products of Indonesia's holding company which has a very wide reach and is one of the largest internet service providers in Indonesia. Based on data from the Indonesia Stock Exchange (https://www.idx.co.id/), the annual report of this holding company of 2018, stated that the number of XYZ subscribers had reached 5.1 million customers and in 2019, the number has increased by 37.2% to 7 million subscribers. It reached market share of 85% (www.kompas.com). It is estimated that by 2020 the demand will increase significantly. This company is continually trying to maximize the internet network and its performance throughout Indonesia. Even though some efforts have been done, however, there are several unmet services and potential rooms for improvement. According to the interview with one of the management teams, it was stated that customers often complain about internet connection both at home and their business ventures. In addition, customer service has been found as the significant issue raised by the customer.

Using purposive sampling method and Taro Yamane formula [12], 100 valid and reliable responses were collected. With respect to the modified SERVQUAL dimensions, there were 22 ISP service attributes finalized. They represented dimensions of tangible, empathy, reliability, responsiveness, and assurance.

IV. RESULTS

This section shows the final ISP service quality attributes, satisfaction score, Kano categorization, linear modeling of Kansei, and prioritized improvement strategies.

A. Kansei words, ISP service quality, customer satisfaction score, and Kano categorization

A mixed simple approach through text mining (using KNIME software), interview with customer, and literature review were used. There were 8 Kansei words and 22 ISP service attributes finalized. These 8 Kansei words were speedy, on-time, accessible, satisfied, stable, reliable, interesting, and affordable. They were the representative of customer emotional needs for ISP service quality and experience. For instance, "speedy" was the dominant need requested by the participants as it was related to the most critical attribute for internet connection. These 8 Kansei words and 22 ISP service attributes were structured in the unified questionnaire. The questions comprised of perception, expectation, and importance of each variable, and Kano categorization as well. The Kano categorization is supposed to strengthen the service quality analysis [4]. The final modified ISP service attributes including the importance, gap (perception and expectation), and satisfaction scores are provided in Table I.

TABLE I
MODIFIED SERVQUAL AND SATISFACTION SCORE

No	Code	ISP Service Attributes	Importance	Gap**	Satisfaction*
1	T1	The appearance of staff	3.68	-0.22	-0.81
2	T2	The physical identity of staff	4.13	-0.35	-1.45
3	T3	The supporting service facility	4.29	-0.59	-2.53
4	T4	The appearance of office room	3.82	-0.25	-0.96
5	T5	The promotion offered	4.1	-0.68	-2.79
6	RL1	The promised service offering	4.39	-1.05	-4.61
7	RL2	The option of internet package	4.19	-0.49	-2.05
8	RL3	The network coverage	4.53	-1.44	-6.52
9	RL4	The price offered	4.33	-0.94	-4.07
10	RL5	The information of internet usage	3.97	-0.66	-2.62
11	RS1	The promptness of customer handling	4.44	-1.26	-5.59
12	RS2	The promptness of service	4.44	-1.25	-5.55
13	RS3	The response of problem solving	4.4	-0.7	-3.08
14	RS4	The response of customer request	4.38	-1.13	-4.95
15	EP1	The provision of customer confidence	4.23	-0.62	-2.62
16	EP2	The courtesy of staff	4.39	-0.4	-1.76
17	EP3	The understanding of any customer concerns	4.28	-0.74	-3.17
18	EP4	The appology to customer to any mistakes	4.16	-0.44	-1.83
19	AS1	The security of customer data	4.53	-0.38	-1.72
20	AS2	The security of service	4.49	-0.43	-1.93
21	AS3	The guarantee againts damaged facility	4.29	-0.65	-2.79
22	AS4	The security of payment	4.41	-0.31	-1.37

** Satisfaction = Importance x Gap; **Gap = Perception - Expectation*

Based on the results of the Table I above, it shows that all service attributes have a negative satisfaction score. This shows that customer satisfaction cannot be fulfilled. In other words, customers are not satisfied with XYZ services. The service attribute with the lowest satisfaction score is the attribute "The network coverage" (RL3).

Regarding the Kano's better-worse categorization, it was found that only 5 service attributes prioritized for improvement. It is referred to Kano's attractive (A) and one-dimensional (O) category, shown in Table II. They are source of innovation and continuous improvement [8].

TABLE II
KANO CATEGORIZATION

No	Code	ISP Service Attributes	Kano Category						Worse	Better	Final
			A	O	M	I	R	Q			
1	T1	The appearance of staff	3	16	31	50	0	0	0.47	0.19	I
2	T2	The physical identity of staff	4	22	44	30	0	0	0.66	0.26	M
3	T3	The supporting service facility	8	32	39	21	0	0	0.71	0.4	M
4	T4	The appearance of office room	17	28	16	39	0	0	0.44	0.45	I
5	T5	The promotion offered	17	37	13	33	0	0	0.5	0.54	A
6	RL1	The promised service offering	2	50	36	12	0	0	0.86	0.52	O
7	RL2	The option of internet package	20	29	16	35	0	0	0.45	0.49	I
8	RL3	The network coverage	5	59	26	10	0	0	0.85	0.64	O
9	RL4	The price offered	25	47	12	16	0	0	0.59	0.72	O
10	RL5	The information of internet usage	21	22	22	35	0	0	0.44	0.43	I
11	RS1	The promptness of customer handling	5	39	44	12	0	0	0.83	0.44	M
12	RS2	The promptness of service	2	45	39	14	0	0	0.84	0.47	M
13	RS3	The response of problem solving	9	32	38	21	0	0	0.7	0.41	M
14	RS4	The response of customer request	8	41	36	15	0	0	0.77	0.49	M
15	EP1	The provision of customer confidence	19	26	21	34	0	0	0.47	0.45	I
16	EP2	The courtesy of staff	8	36	30	26	0	0	0.66	0.44	M
17	EP3	The understanding of any customer concerns	10	33	27	30	0	0	0.6	0.43	M
18	EP4	The appology to customer to any mistakes	9	27	32	32	0	0	0.59	0.36	M
19	AS1	The security of customer data	3	39	44	14	0	0	0.83	0.42	M
20	AS2	The security of service	4	35	43	18	0	0	0.78	0.39	M
21	AS3	The guarantee againts damaged facility	19	42	15	24	0	0	0.57	0.61	O
22	AS4	The security of payment	3	44	36	17	0	0	0.8	0.47	M

Note: the gray-shaded service attributes are prioritized for improvement

B. Linear Model and Prioritized Improvement

Once the Kano categorization was done, through linear regression analysis, the linear model between Kansei and Kano's A & O service attributes was set (see Table III). This linear regression model is to recall that Kansei is a function of perceived ISP service attribute(s) with Kano's A & O categories.

TABLE III
LINEAR MODEL

Kansei	Linear Model	R-sq	Significant Value
Speedy (K1)	K1 = 1.792 + 0.362 RL1 + 0.417 RL4	43.40%	0.000
Ontime (K2)	K2 = 2.752 + 0.510 RL1 + 0.264 RL4	50.02%	0.000
Accessible (K3)	K3 = 3.133 + 0.234 RL1	36.70%	0.001
Satisfied (K4)	K4 = 2.226 + 0.335 RL1	61.08%	0.000
Stable (K5)	K5 = 2.112 + 0.322 RL3	44.60%	0.000
Reliable (K6)	K6 = 1.951 + 0.277 RL4 + 0.198 RL3	61.23%	0.001
Interesting (K7)	K7 = 2.190 + 0.411 RL4 + 0.280 RL1	49.76%	0.000
Affordable (K8)	K8 = 2.066 + 0.587 RL4	48.11%	0.000

Afterward, the total weight for the significant service attributes (i.e., RL1, RL3, and RL4) is calculated. Total weight = Importance of WHATs = |satisfaction score| x Kano's category weight x number of Kansei x Kansei score [9]. The explanation for each element of total weight is as follows. |Satisfaction score| is taken from Table I; the Kano's category weight is set to be Attractive (A) = 4, One-Dimensional (O) = 2; number of Kansei is taken from the number of Kansei which are significant to a particular ISP service attribute; Kansei score is taken from the perceived value of Kansei. The result of total weight is provided in Table IV.

TABLE IV
TOTAL WEIGHT FOR SIGNIFICANT SERVICE ATTRIBUTES

ISP Service Attribute	Satisfaction	Kano	Kano Weight	# of Kansei	Kansei score	Total weight	%
RL1	4.61	O	2	5	4.57	210.65	47.06%
RL3	6.52	O	2	1	4.25	55.45	12.39%
RL4	4.07	O	2	5	4.46	181.53	40.55%

V. DISCUSSION

Based on the results as discussed in sub-chapter IV above, using Pareto principle there were two ISP service attributes prioritized, i.e., RL1 (the promised service offering) and RL 4 (the price offered). Due to possible constraints (e.g., budget, time, effort), the RL1 (with total weight of 47.06%) was chosen to follow up. Through literature review, focus group discussion and interview with customers and management of XYZ, by using need-metric of House of Quality (HoQ), there were several improvement elements. They include: (i) Provision of service standard for handling customer complaint and problem, (ii) Provision of 24-hour service, and (iii) Provision of excellent communication from technician and staff.

According to the three improvement elements mentioned previously, the Taguchi method using 2-level is proposed. The description of 2-level for each improvement element (known as factor) was done through brainstorming with management and customer of XYZ. The result is shown in Table V.

TABLE V
DESCRIPTION OF 2-LEVEL OF EACH FACTOR USING TAGUCHI

Taguchi Factor	Improvement Element	Level 1	Level 2
A	Provision of service standard for handling customer complaint and problem	Making written procedures about the standard time estimation which is informed to all	Making written procedures about the standard time estimation which is informed to the customer
B	Provision of 24-hour service	Providing 24-hour service which applies to all divisions including technicians	Providing 24-hour service which applies to customer care
C	Provision of excellent communication from technician and staff	Emphasising all staff to always show empathy and good communication to customers	Emphasising the customer care to always show empathy and good communication to customers

Based on a literature study and considering the factors and levels of each factor, this test uses L_4 orthogonal array experiment design (i.e., it accommodates 3 factors with 2 levels each) without any interaction between factors (no interaction). In this design, in order to determine the design combination that will be used, it requires opinions or perceptions from XYZ customers regarding some of these design proposals. Therefore, to get a response from customers, it is necessary to distribute questionnaires using a Likert scale [10, 11]. After obtaining the results of the questionnaire, it was then tested using the larger is better signal-to-noise ratio (S/N ratio); it is shown in Table VI and VII. It seems that the Taguchi Factor A is the most important or critical as it has the highest delta or gap between the mean S/N ratio of level 1 and 2. It is followed by the Taguchi Factor B and C.

TABLE VI
TAGUCHI TEST

Run	Factors			Mean of Response	S/N Ratio
	A	B	C		
1	1	1	1	3.97	11.97
2	1	2	2	4.13	12.32
3	2	1	2	3.48	10.83
4	2	2	1	3.74	11.45

TABLE VII
S/N RATIO TEST

Level	Factors		
	A	B	C
1	12.145	11.4	11.71
2	11.14	11.885	11.575
Delta	1.005	0.485	0.135
Rank	1	2	3

Regarding the most critical robust-based

improvement strategy which is also fulfilling the emotional needs (Kansei) is that factor A with level 1 (i.e., making written procedures about the standard time estimation which is informed to all staff and customer). It will bring the certainty of duration of service, and expectation how long the customer is willing to wait. Nevertheless, the provision of 24-hour customer care service and strong empathy to customer given by all staff are critical as well.

VI. CONCLUSION

This study discusses how Kansei Engineering. (KE) shows its flexibility and superiority by engaging the Kansei mining process applied to the improvement of internet service quality. It is beneficial for Internet Service Providers (ISPs) in order to continuously improve their service quality and performance by promoting the fulfilment of customer's emotional needs (Kansei). The critical ISP service attributes which are significantly connected to dominant Kansei will be identified and prioritized for improvement. The formed improvement strategies are then enhanced by the Taguchi methodology, in order to promote more robust solution.

This study is limited to the relatively small number of participant and data collection through online survey. For more comprehensive and conclusive contribution, in the future, it is recommended to apply mixed methods (i.e., both qualitative and quantitative research methods) and take more data in other ISPs. More comprehensive sentiment analysis for text mining process is encouraged.

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